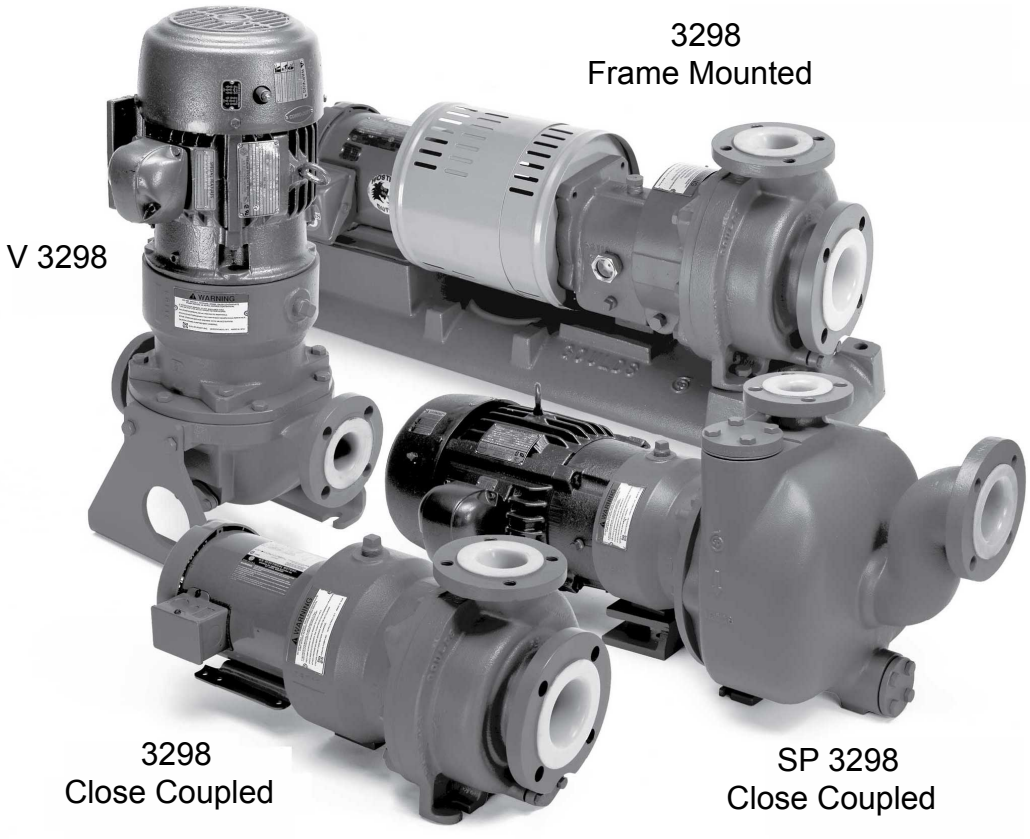
ITT

Goulds Pumps

Installation, Operation, and Maintenance Manual

3298 Family



Engineered for life

Table of Contents

Introduction and Safety

Introduction

Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance

CAUTION:

Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

NOTICE:

Save this manual for future reference, and keep it readily available at the location of the unit.

Requesting other information

Special versions can be supplied with supplementary instruction leaflets. See the sales contract for any modifications or special version characteristics. For instructions, situations, or events that are not considered in this manual or in the sales documents, please contact the nearest ITT representative.

Always specify the exact product type and identification code when requesting technical information or spare parts.

Safety

WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Any pressure-containing device can explode, rupture, or discharge its contents if it is over-pressurized. Take all necessary measures to avoid over-pressurization.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by ITT. If there is a question regarding the intended use of the equipment, please contact an ITT representative before proceeding.
- This manual clearly identifies accepted methods for disassembling units. These methods must be adhered to. Trapped liquid can rapidly expand and result in a violent explosion and injury. Never apply heat to impellers, propellers, or their retaining devices to aid in their removal.
- Do not change the service application without the approval of an authorized ITT representative.

CAUTION:

You must observe the instructions contained in this manual. Failure to do so could result in physical injury, damage, or delays.

Safety terminology and symbols

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product
- Product malfunction

Hazard levels

Hazard level	Indication
 **DANGER:**	A hazardous situation which, if not avoided, will result in death or serious injury
 **WARNING:**	A hazardous situation which, if not avoided, could result in death or serious injury
 **CAUTION:**	A hazardous situation which, if not avoided, could result in minor or moderate injury
NOTICE:	• A potential situation which, if not avoided, could result in undesirable conditions • A practice not related to personal injury

Hazard categories

Hazard categories can either fall under hazard levels or let specific symbols replace the ordinary hazard level symbols.

Electrical hazards are indicated by the following specific symbol:

Electrical Hazard:

These are examples of other categories that can occur. They fall under the ordinary hazard levels and may use complementing symbols:

- Crush hazard
- Cutting hazard
- Arc flash hazard

The Ex symbol

The Ex symbol indicates safety regulations for Ex-approved products when used in atmospheres that are potentially explosive or flammable.

Environmental safety

The work area

Always keep the station clean to avoid and/or discover emissions.

Waste and emissions regulations

Observe these safety regulations regarding waste and emissions:

- Appropriately dispose of all waste.
- Handle and dispose of the processed liquid in compliance with applicable environmental regulations.
- Clean up all spills in accordance with safety and environmental procedures.
- Report all environmental emissions to the appropriate authorities.

Electrical installation

For electrical installation recycling requirements, consult your local electric utility.

Recycling guidelines

Always follow local laws and regulations regarding recycling.

User safety

General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Helmet
- Safety goggles, preferably with side shields
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- First-aid kit
- Safety devices

NOTICE:

Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations. For more information about requirements, see sections dealing specifically with electrical connections.

Magnetic precautions

WARNING:

Magnetic drive pumps contain very strong magnets that can pose health risks. Always observe these guidelines:

- Avoid working with, being in proximity of, or handling the magnets contained in this pump if you have any of these conditions:
  - An artificial cardiac pacemaker
  - An implanted defibrillator
  - A metallic prosthetic heart valve
  - Internal wound clips, from surgery
  - Prosthetic joints
  - Metallic wiring
  - Any other type of metallic, prosthetic device
- Individuals who have had any surgery, especially to the chest or head, and do not know if metallic clips were surgically implanted need to avoid work on this unit unless their physician can confirm that no metallic devices exist.

Wash the skin and eyes

Do the following if chemicals or hazardous fluids have come into contact with your eyes or your skin:

If you need to wash your...	Then...
Eyes	1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.
Skin	1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least one minute. 3. Seek medical attention, if required.

Ex-approved products

Follow these special handling instructions if you have an Ex-approved unit.

Personnel requirements

These are the personnel requirements for Ex-approved products in potentially explosive atmospheres:

- All work on the product must be carried out by certified electricians and ITT-authorized mechanics. Special rules apply to installations in explosive atmospheres.
- All users must know about the risks of electric current and the chemical and physical characteristics of the gas, the vapor, or both present in hazardous areas.
- Any maintenance for Ex-approved products must conform to international and national standards (for example, IEC/EN 60079-17).

ITT disclaims all responsibility for work done by untrained and unauthorized personnel.

Product and product handling requirements

These are the product and product handling requirements for Ex-approved products in potentially explosive atmospheres:

- Only use the product in accordance with the approved motor data.
- The Ex-approved product must never run dry during normal operation. Dry running during service and inspection is only permitted outside the classified area.
- Before you start work on the product, make sure that the product and the control panel are isolated from the power supply and the control circuit, so they cannot be energized.
- Do not open the product while it is energized or in an explosive gas atmosphere.

- Make sure that thermal contacts are connected to a protection circuit according to the approval classification of the product, and that they are in use.
- Intrinsically safe circuits are normally required for the automatic level-control system by the level regulator if mounted in zone 0.
- The yield stress of fasteners must be in accordance with the approval drawing and the product specification.
- Do not modify the equipment without approval from an authorized ITT representative.
- Only use parts that are provided by an authorized ITT representative.

Description of ATEX

The ATEX directives are a specification enforced in Europe for electrical and non-electrical equipment installed in Europe. ATEX deals with the control of potentially explosive atmospheres and the standards of equipment and protective systems used within these atmospheres. The relevance of the ATEX requirements is not limited to Europe. You can apply these guidelines to equipment installed in any potentially explosive atmosphere.

Guidelines for compliance

Compliance is fulfilled only when you operate the unit within its intended use. Do not change the conditions of the service without the approval of an ITT representative. When you install or maintain explosion proof products, always comply with the directive and applicable standards (for example, IEC/EN 60079–14).

Monitoring equipment

For additional safety, use condition-monitoring devices. Condition-monitoring devices include but are not limited to these devices:

- Pressure gauges
- Flow meters
- Level indicators
- Motor load readings
- Temperature detectors
- Bearing monitors
- Leak detectors
- PumpSmart control system

Product warranty

Coverage

ITT undertakes to remedy faults in products from ITT under these conditions:

- The faults are due to defects in design, materials, or workmanship.
- The faults are reported to an ITT representative within the warranty period.
- The product is used only under the conditions described in this manual.
- The monitoring equipment incorporated in the product is correctly connected and in use.
- All service and repair work is done by ITT-authorized personnel.
- Genuine ITT parts are used.
- Only Ex-approved spare parts and accessories authorized by ITT are used in Ex-approved products.

Limitations

The warranty does not cover faults caused by these situations:

- Deficient maintenance
- Improper installation
- Modifications or changes to the product and installation made without consulting ITT

- Incorrectly executed repair work
- Normal wear and tear

ITT assumes no liability for these situations:

- Bodily injuries
- Material damages
- Economic losses

Warranty claim

ITT products are high-quality products with expected reliable operation and long life. However, should the need arise for a warranty claim, then contact your ITT representative.

Transportation and Storage

Inspect the delivery

Inspect the package

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.
   If the product has been picked up at a distributor, make a claim directly to the distributor.

Inspect the unit

1. Remove packing materials from the product.
   Dispose of all packing materials in accordance with local regulations.
2. Inspect the product to determine if any parts have been damaged or are missing.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.
   For your personal safety, be careful when you handle nails and straps.
4. Contact your sales representative if anything is out of order.

Transportation guidelines

Precautions

WARNING:

- Stay clear of suspended loads.
- Observe accident prevention regulations in force.

Pump handling

WARNING:

- Make sure that the pump cannot roll or fall over and injure people or damage property.
- These pumps might use carbon or ceramic silicon carbide components. Do not drop the pump or subject it to shock loads as this can damage the internal ceramic components.

NOTICE: Use a forklift truck or an overhead crane with sufficient capacity to move the pallet with the pump unit on top. Failure to do so can result in equipment damage.

Lifting methods

WARNING:

- Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- Do not attach sling ropes to shaft ends.

Table 1: Methods

Pump type	Lifting method
A bare pump without lifting handles	Use a suitable sling attached properly to solid points like the casing, the flanges, or the frames.
A base-mounted pump	Use slings under the pump casing and the drive unit, or under the base rails.

Examples

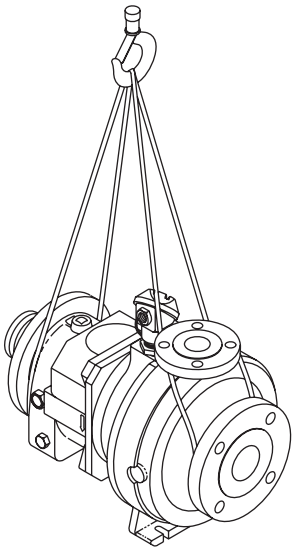


Figure 1: Proper lifting method for a bare pump

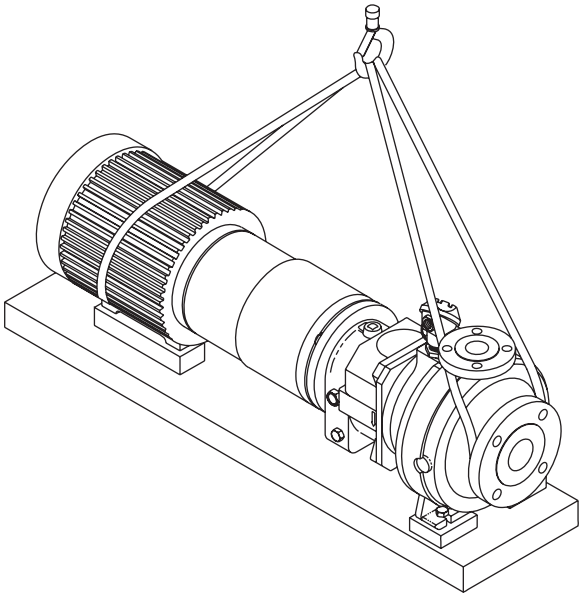


Figure 2: Proper lifting method for a pump with a base and driver

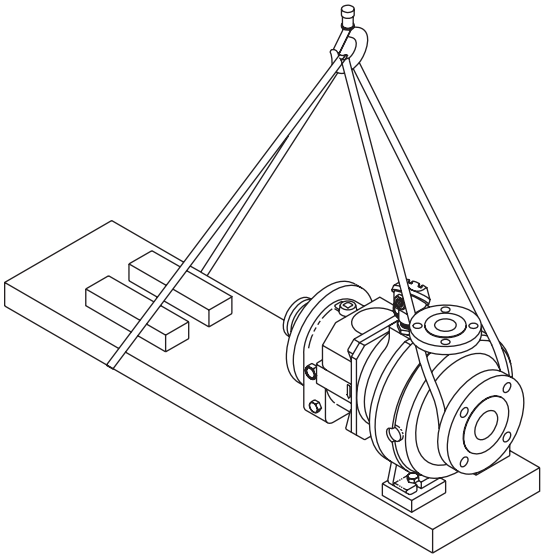


Figure 3: Proper lifting method for a pump with a base and no driver

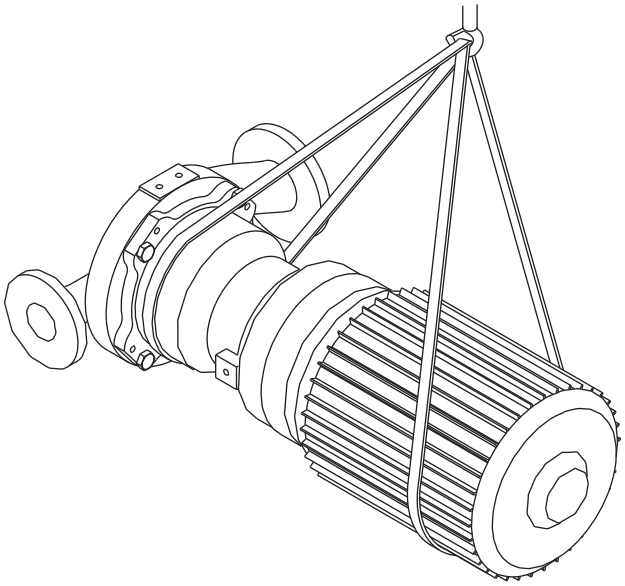


Figure 4: Proper lifting method for a vertical pump with a driver

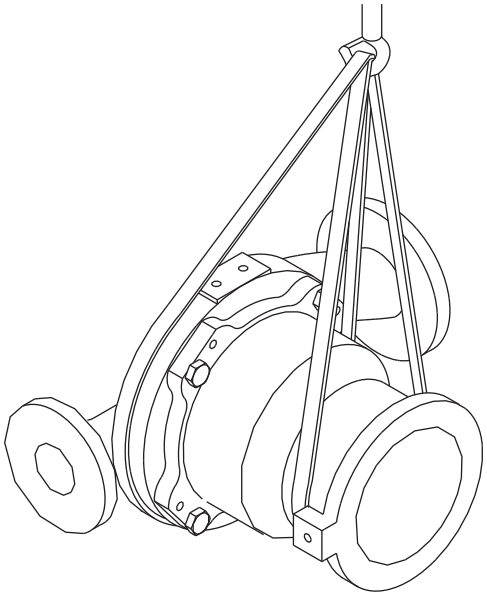


Figure 5: Proper lifting method for a vertical pump with no driver

Storage guidelines

Pump storage requirements

Storage requirements depend on the amount of time that you store the pump. The normal packaging is designed only to protect the pump during shipping.

Length of time in storage	Storage requirements
Upon receipt/short-term (less than six months)	• Store in a covered and dry location. • Store the unit free from dirt and vibrations.

Length of time in storage	Storage requirements
Long-term (more than six months)	• Store in a covered and dry location. • Store the unit free from heat, dirt, and vibrations. • Rotate the shaft by hand several times at least every three months.

Treat bearing and machined surfaces so that they are well preserved. Refer to drive unit and coupling manufacturers for their long-term storage procedures.

You can purchase long-term storage treatment with the initial pump order or you can purchase it and apply it after the pumps are already in the field. Contact your local ITT sales representative.

Product Description

General description

Model 3298

Model 3298 is a sealless, close-coupled or frame-mounted, centrifugal pump with an enclosed impeller that is driven by a synchronous magnetic coupling. All sizes of the 3298 meet the dimensional standards of ANSI B73.1 except for 1x1.5-5 and the 1.5x2-6.

Model SP3298

SP3298 is a self-priming, sealless, close-coupled or frame-mounted, centrifugal pump with an enclosed impeller that is driven by a synchronous magnetic coupling. The pump and the frame or adapter feet locations meet ANSI B73.1 dimensional standards.

Model V 3298

V3298 is a vertical in-line, sealless, close-coupled centrifugal pump with an enclosed impeller that is driven by a synchronous magnetic coupling. Model V3298 meets the dimensional standards of ANSI B73.2.

Casing

The casings are one-piece cast ductile iron lined with 1/8-inch Tefzel®1 and have ANSI class 150 flanges with a Tefzel® raised face. The 3298 and SP3298 are end-suction, top centerline discharge, and are self-venting. The V3298 is side-suction, side-discharge, and is also self-venting.

Impeller magnet assembly

The 3298 family uses a one- or two-piece impeller magnet assembly. The magnet ring is balanced to ISO 1940 G6.3 levels and is sealed within the solid, enclosed Tefzel® impeller magnet assembly.

Stationary shaft

The impeller magnet assembly rotates about a solid stationary silicon carbide shaft. The shaft is supported at one end by the containment shell and at the other end by the Tefzel® bearing spider.

Bearing spider

The bearing spider, constructed from solid Tefzel®, houses one of the key silicon carbide thrust bearings in the pump and supports the stationary shaft at one end.

Rear impeller wear ring

A rear impeller wear ring is standard on M and L group pumps. A wear ring is not required on theS group. The wear ring is pressed into the rear of the impeller assembly. The wear ring reduces axial thrust in the M and L group pumps.

Magnetic coupling

The magnetic coupling is a coaxial synchronous type using rare earth magnets of neodymium iron (NdFe). This concept results in a compact design and allows the impeller to turn at the same speed as the motor, which means that there is no slip between the drive and the driven magnets.

Containment shell

The containment shell isolates the pumped liquid from the atmosphere. The containment shell construction is backed with vinylester FRP.

Bearings

The standard material for radial bearings and thrust bearings is carbon. Pure Sintered Alpha Grade Silicon Carbide or DryGuard™ Pure Sintered Alpha Grade Silicon Carbide are optional.

Standard close-coupled mounting

The drive magnet assembly is keyed, setscrewed, and mounted directly to the motor shaft. This arrangement eliminates the need to perform pump-to-motor alignment.

Optional frame-mounted power end

The standard configuration for the optional power end is cast iron with flood-oil-lubricated ball bearings. Pure oil mist systems are available as an option. For the protection and reliability of the bearings and the lubricant, a labyrinth seal is provided. On the inboard side a lip seal is used to prevent leakage of oil into the magnetic drive assembly. The frame-mounted power end is not available on the V3298.

Nameplate information

Important information for ordering

Every pump has nameplates that provide information about the pump. The nameplates are located on the casing and the bearing frame.

When you order spare parts, identify this pump information:

- Model
- Size
- Serial number
- Item numbers of the required parts

Refer to the nameplate on the pump casing for most of the information. See Parts List for item numbers.

Nameplate types

Nameplate	Description
Pump casing	Provides information about the hydraulic characteristics of the pump. The formula for the pump size is: Discharge x Suction - Nominal Maximum Impeller Diameter in inches. (Example: 2x3-8)
Bearing frame	Provides information about the lubrication system used.
ATEX	If applicable, your pump unit might have an ATEX nameplate affixed to the pump, the baseplate, or the discharge head. The nameplate provides information about the ATEX specifications of this pump.

Nameplate on the pump casing using English units

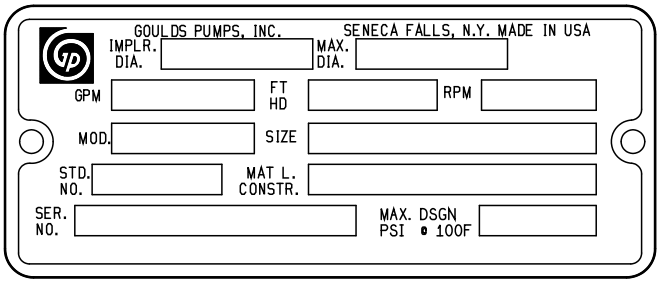


Table 2: Explanation of nameplate on the pump casing

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter, in inches
MAX. DIA.	Maximum impeller diameter, in inches
GPM	Rated pump flow, in gallons per minute
FT HD	Rated pump head, in feet
RPM	Rated pump speed, revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	ANSI standard designation

Nameplate field	Explanation
MAT L. CONST.	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX DSGN PSI @ 100F	Maximum pressure at 100ºF according to the pump design

Nameplate on the pump casing using metric units

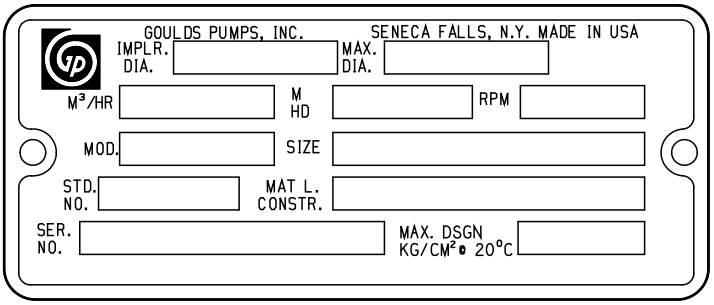


Table 3: Explanation of the nameplate on the pump casing

Nameplate field	Explanation
IMPLR. DIA.	Impeller diameter
MAX. DIA.	Maximum impeller diameter
M^3/HR	Rated pump flow, in cubic meters per hour
M HD	Rated pump head, in meters
RPM	Rated pump speed, in revolutions per minute
MOD.	Pump model
SIZE	Size of the pump
STD. NO.	ANSI standard designation
MAT L. CONST	Material of which the pump is constructed
SER. NO.	Serial number of the pump
MAX. DSGN KG/CM^3 @ 20°C	Kilograms per cubic centimeter at 20°C

Nameplate on the bearing frame

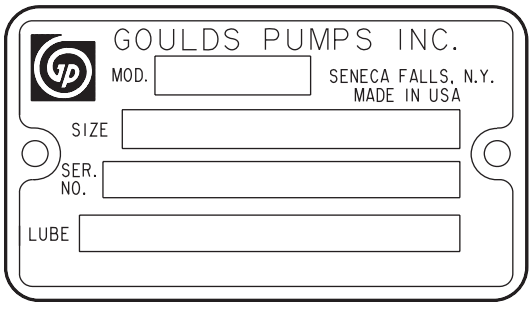


Table 4: Explanation of the nameplate on the bearing frame

Nameplate field	Explanation
MOD.	Pump model
SIZE	Size of the pump
SER. NO.	Serial number of the pump

Nameplate field	Explanation
LUBE	Lubricant, oil or grease

ATEX nameplate

Nameplate field	Explanation
II	Group 2
2	Category 2
G/D	Pump can be used when gas and dust are present
T4	Temperature class

Table 5: Temperature class definitions

Code	Maximum permissible surface temperature in °F (°C)	Minimum permissible surface temperature in °F (°C)
T1	842 (450)	700 (372)
T2	572 (300)	530 (277)
T3	392 (200)	350 (177)
T4	275 (135)	235 (113)
T5	212 (100)	Option not available
T6	185 (85)	Option not available

NOTICE: Make sure that the code classifications on the pump are compatible with the specific environment in which you plan to install the equipment. If they are not compatible, do not operate the equipment and contact your ITT representative before you proceed.

Installation

Preinstallation

Precautions

WARNING:

- When installing in a potentially explosive environment, make sure that the motor is properly certified.
- You must earth (ground) all electrical equipment. This applies to the pump equipment, the driver, and any monitoring equipment. Test the earth (ground) lead to verify that it is connected correctly.

NOTICE: Supervision by an authorized ITT representative is recommended to ensure proper installation. Failure to do so may result in equipment damage or decreased performance.

Evaluate the installation in order to determine that the Net Positive Suction Head Available ($NPSH_A$) meets or exceeds the Net Positive Suction Head Required ($NPSH_R$), as stated by the pump performance curve.

Pump location guidelines

WARNING:

Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.

Guideline	Explanation/comment
Keep the pump as close to the liquid source as practically possible.	This minimizes the friction loss and keeps the suction piping as short as possible.
Make sure that the space around the pump is sufficient.	This facilitates ventilation, inspection, maintenance, and service.
If you require lifting equipment such as a hoist or tackle, make sure that there is enough space above the pump.	This makes it easier to properly use the lifting equipment and safely remove and relocate the components to a safe location.
Protect the unit from weather and water damage due to rain, flooding, and freezing temperatures.	This is applicable if nothing else is specified.
Do not install and operate the equipment in closed systems unless the system is constructed with properly-sized safety devices and control devices.	Acceptable devices: • Pressure relief valves • Compression tanks • Pressure controls • Temperature controls • Flow controls If the system does not include these devices, consult the engineer or architect in charge before you operate the pump.
Take into consideration the occurrence of unwanted noise and vibration.	The best pump location for noise and vibration absorption is on a concrete floor with subsoil underneath.
If the pump location is overhead, undertake special precautions to reduce possible noise transmission.	Consider a consultation with a noise specialist.

Foundation requirements

Precautions

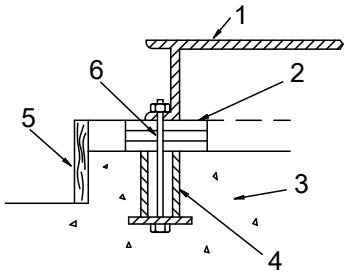
CAUTION:

If your pump is a Model NM3171, NM3196, 3198, 3298, V3298, SP3298, 4150, 4550, or 3107 there is a possible risk of static electric discharge from plastic parts that are not properly grounded. If the pumped fluid is non-conductive, drain and flush the pump with a conductive fluid under conditions that will not allow for a spark to be released to the atmosphere.

Requirements

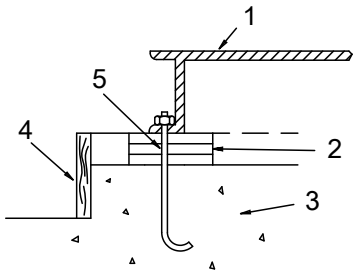
- The foundation must be able to absorb any type of vibration and form a permanent, rigid support for the unit.
- The location and size of the foundation bolt holes must match those shown on the assembly drawing provided with the pump data package.
- The foundation must weigh between two and three times the weight of the pump.
- Provide a flat, substantial concrete foundation in order to prevent strain and distortion when you tighten the foundation bolts.
- Sleeve-type and J-type foundation bolts are most commonly used. Both designs allow movement for the final bolt adjustment.

Sleeve-type bolts



1. Baseplate
2. Shims or wedges
3. Foundation
4. Sleeve
5. Dam
6. Bolt

J-type bolts



1. Baseplate
2. Shims or wedges
3. Foundation
4. Dam
5. Bolt

Baseplate-mounting procedures

Prepare the baseplate for mounting

1. Remove all the attached equipment from the baseplate.
2. Clean the underside of the baseplate completely.
3. If applicable, coat the underside of the baseplate with an epoxy primer.

   Use an epoxy primer only if you used an epoxy-based grout.
4. Remove the rust-proofing coat from the machined mounting pads using an appropriate solvent.
5. Remove water and debris from the foundation-bolt holes.

Install the baseplate using shims or wedges

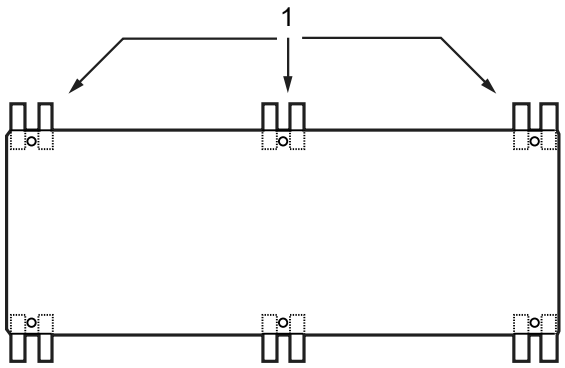
Required tools:

- Two sets of shims or wedges for each foundation bolt
- Two machinist's levels
- Baseplate-leveling worksheet

This procedure is applicable to cast iron and fabricated steel baseplates.

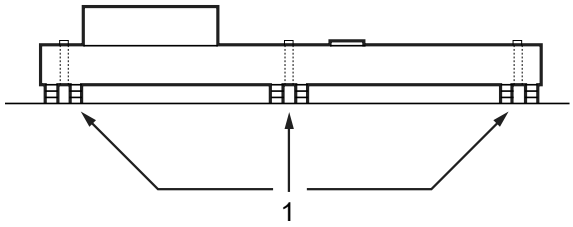
1. Remove water and debris from the anchor bolt holes and sleeves.
2. If you use sleeve-type bolts, fill the bolt sleeves with packing material or rags to prevent grout from entering the bolt holes.
3. Put the sets of wedges or shims on each side of each foundation bolt.

   Make sure that the wedges extend 0.75 in. (19 mm) to 1.5 in. (38 mm) above the foundation to provide adequate space for grouting. The wedges will provide adequate support for the baseplate after it is grouted.



1. Shims or wedges

Figure 6: Top view



1. Shims or wedges

Figure 7: Side view

4. Lower the baseplate carefully onto the foundation bolts.
5. Put the machinist's levels across the mounting pads of the driver and the mounting pads of the pump.

NOTICE: Remove all dirt from the mounting pads in order to make sure that you achieve the correct leveling. Failure to do so can result in equipment damage or decreased performance.

6. Level the baseplate both lengthwise and across by adding or removing shims or moving the wedges.

   These are the leveling tolerances:

   - A maximum difference of 0.125 in. (3.2 mm) lengthwise
   - A maximum difference of 0.059 in. (1.5 mm) across

   You can use the baseplate-leveling worksheet when you take the readings.
7. Hand-tighten the nuts for the foundation.

Install the baseplate using jackscrews

Tools required:

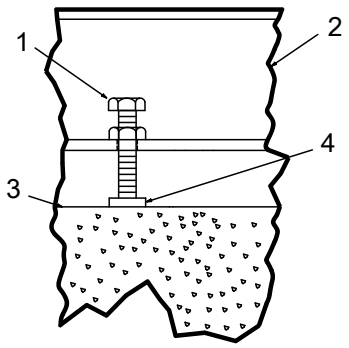
- Anti-seize compound
- Jackscrews
- Bar stock
- Two machinist's levels
- Baseplate-leveling worksheet

This procedure applies to the feature-fabricated steel baseplate and the advantage base baseplate.

1. Apply an anti-seize compound on the jackscrews.

   The compound makes it easier to remove the screws after you grout.
2. Lower the baseplate carefully onto the foundation bolts and perform these steps:
   a) Cut the plates from the bar stock and chamfer the edges of the plates in order to reduce stress concentrations.
   b) Put the plates between the jackscrews and the foundation surface.
   c) Use the four jackscrews in the corners in order to raise the baseplate above the foundation.

      Make sure that the distance between the baseplate and the foundation surface is between 0.75 in. (19 mm) and 1.50 in. (38 mm).
   d) Make sure that the center jackscrews do not touch the foundation surface yet.



1. Jackscrew
2. Baseplate
3. Foundation
4. Plate

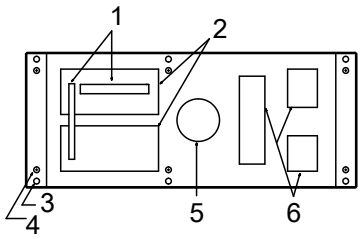
3. Level the driver mounting pads:

NOTICE: Remove all dirt from the mounting pads in order to make sure that you achieve the correct leveling. Failure to do so can result in equipment damage or decreased performance.

   a) Put one machinist's level lengthwise on one of the two pads.
   b) Put the other machinist's level across the ends of the two pads.
   c) Level the pads by adjusting the four jackscrews in the corners.

Make sure that the machinist's level readings are as close to zero as possible, both lengthwise and across.

Use the baseplate-leveling worksheet when you take the readings.



1. Machinist's levels
2. Driver's mounting pads
3. Foundation bolts
4. Jackscrews
5. Grout hole
6. Pump's mounting pads

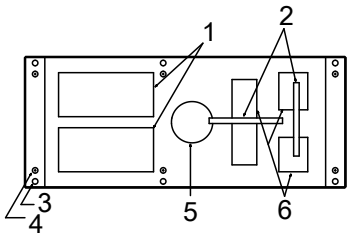
4. Turn the center jackscrews down so that they rest on their plates on the foundation surface.
5. Level the pump mounting pads:

NOTICE: Remove all dirt from the mounting pads in order to make sure that you achieve the correct leveling. Failure to do so can result in equipment damage or decreased performance.

---

a) Put one machinist's level lengthwise on one of the two pads.
b) Put the other level across the center of the two pads.
c) Level the pads by adjusting the four jackscrews in the corners.

Make sure that the machinist's level readings are as close to zero as possible, both lengthwise and across.



1. Driver's mounting pads
2. Machinist's levels
3. Foundation bolts
4. Jackscrews
5. Grout hole
6. Pump's mounting pads

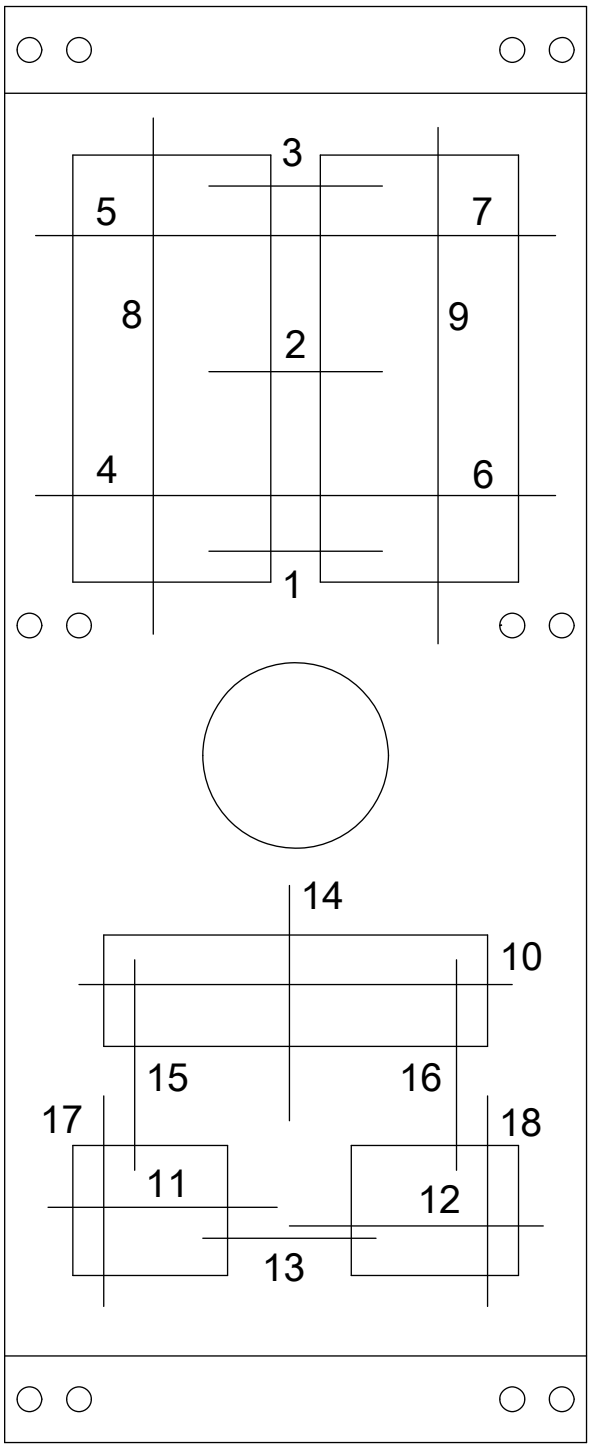
6. Hand-tighten the nuts for the foundation bolts.
7. Check that the driver's mounting pads are level and adjust the jackscrews and the foundation bolts if necessary.

The correct level measurement is a maximum of 0.002 in./ft (0.0167 mm/m).

The maximum variation from one side of the baseplate to the other is 0.015 in. (0.38 mm).

Baseplate-leveling worksheet

Level measurements



1)_____

2)_____

3)_____

4)_____

5)_____

6)_____

7)_____

8)_____

9)_____

10)_____

11)_____

12)_____

13)_____

14)_____

15)_____

16)_____

17)_____

18)_____

Pump-to-driver alignment

Precautions

WARNING:

- Follow shaft alignment procedures in order to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow the coupling installation and operation procedures from the coupling manufacturer.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

NOTICE: Proper alignment is the responsibility of the installer and the user of the unit. Check the alignment of frame-mounted units before you operate the unit. Failure to do so can result in equipment damage or decreased performance.

Alignment methods

Three common alignment methods are used:

- Dial indicator
- Reverse dial indicator
- Laser

Follow the instructions from the equipment manufacturer when you use the reverse dial indicator or laser methods. Detailed instructions for using the dial indicator method are contained in this chapter.

Alignment checks

When to perform alignment checks

You must perform alignment checks under these circumstances:

- The process temperature changes.
- The piping changes.
- The pump has been serviced.

Types of alignment checks

Type of check	When it is used
Initial alignment (cold alignment) check	Prior to operation when the pump and the driver are at ambient temperature.
Final alignment (hot alignment) check	After operation when the pump and the driver are at operating temperature.

Initial alignment (cold alignment) checks

When	Why
Before you grout the baseplate	This ensures that alignment can be accomplished.
After you grout the baseplate	This ensures that no changes have occurred during the grouting process.
After you connect the piping	This ensures that pipe strains have not altered the alignment. If changes have occurred, you must alter the piping to remove pipe strains on the pump flanges.

Final alignment (hot alignment) checks

When	Why
After the first run	This ensures correct alignment when both the pump and the driver are at operating temperature.
Periodically	This follows the plant operating procedures.

Permitted indicator values for alignment checks

NOTICE: The specified permitted reading values are valid only at operating temperature. For cold settings, other values are permitted. You must use the correct tolerances. Failure to do so can result in misalignment and reduced pump reliability.

When dial indicators are used to check the final alignment, the pump and drive unit are correctly aligned when these conditions are true:

- The total indicator runout is a maximum of 0.002 in. (0.05 mm) at operating temperature.
- The tolerance of the indicator is 0.0005 in./in. (0.0127 mm/mm) of indicator separation at operating temperature.

Alignment measurement guidelines

Guideline	Explanation
Rotate the pump coupling half and the driver coupling half together so that the indicator rods have contact with the same points on the driver coupling half.	This prevents incorrect measurement.
Move or shim only the driver in order to make adjustments.	This prevents strain on the piping installations.
Make sure that the hold-down bolts for the driver feet are tight when you take indicator measurements.	This keeps the driver stationary since movement causes incorrect measurement.
Make sure that the hold-down bolts for the driver feet are loose before you make alignment corrections.	This makes it possible to move the driver when you make alignment corrections.
Check the alignment again after any mechanical adjustments.	This corrects any misalignments that an adjustment may have caused.

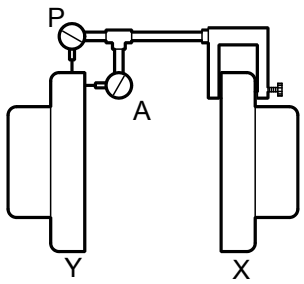
Attach the dial indicators for alignment

You must have two dial indicators in order to complete this procedure.

1. Attach two dial indicators on the pump coupling half (X):
   a) Attach one indicator (P) so that the indicator rod comes into contact with the perimeter of the driver coupling half (Y).

      This indicator is used to measure parallel misalignment.
   b) Attach the other indicator (A) so that the indicator rod comes into contact with the inner end of the driver coupling half.

      This indicator is used to measure angular misalignment.



2. Rotate the pump coupling half (X) in order to check that the indicators are in contact with the driver coupling half (Y) but do not bottom out.
3. Adjust the indicators if necessary.

Pump-to-driver alignment instructions

Perform angular alignment for a vertical correction

1. Set the angular alignment indicator to zero at the top-center position (12 o'clock) of the driver coupling half (Y).
2. Rotate the indicator to the bottom-center position (6 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The coupling halves are farther apart at the bottom than at the top. Perform one of these steps: • Add shims in order to raise the feet of the driver at the shaft end. • Remove shims in order to lower the feet of the driver at the other end.
Positive	The coupling halves are closer at the bottom than at the top. Perform one of these steps: • Remove shims in order to lower the feet of the driver at the shaft end. • Add shims in order to raise the feet of the driver at the other end.

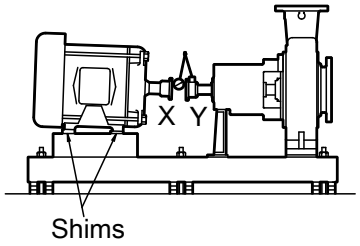


Figure 8: Side view of an incorrect vertical alignment

4. Repeat the previous steps until the permitted reading value is achieved.

   Maximum permitted value for angular alignment:

   • 0.002 in. (0.05 mm) total indicated runout at operating temperature

Perform angular alignment for a horizontal correction

1. Set the angular alignment indicator (A) to zero on left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicator through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The coupling halves are farther apart on the right side than the left. Perform one of these steps: • Slide the shaft end of the driver to the left. • Slide the opposite end to the right.
Positive	The coupling halves are closer together on the right side than the left. Perform one of these steps: • Slide the shaft end of the driver to the right. • Slide the opposite end to the left.

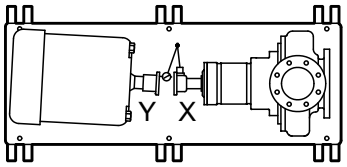


Figure 9: Top view of an incorrect horizontal alignment

4. Repeat the previous steps until the permitted reading value is achieved.

   Maximum permitted value for angular alignment:

   - 0.002 in. (0.05 mm) total indicated runout at operating temperature

Perform parallel alignment for a vertical correction

Before you start this procedure, make sure that the dial indicators are correctly set up.

A unit is in parallel alignment when the parallel indicator (P) does not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart at the operating temperature.

When aligning a cold unit, see the Cold settings for vertical parallel alignment table.

1. Set the parallel alignment indicator to zero at the top-center position (12 o'clock) of the driver coupling half.
2. Rotate the indicator to the bottom-center position (6 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The pump coupling half (X) is lower than the driver coupling half (Y). Remove shims of a thickness equal to half of the indicator reading value under each driver foot.
Positive	The pump coupling half (X) is higher than the driver coupling half. Add shims of a thickness equal to half of the indicator reading value to each driver foot.

NOTICE:

You must use an equal amount of shims with each driver foot to prevent misalignment. Failure to do so can result in equipment damage or decreased performance.

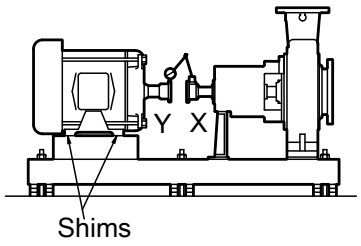


Figure 10: Side view of an incorrect vertical alignment

4. Repeat the previous steps until the permitted reading value is achieved.

Maximum permitted value for parallel alignment:

- 0.002 in. (0.05 mm) total indicated runout at operating temperature

During installation, when the pump is cold, adjust the parallel vertical alignment to a setting that allows for expansion rates of the pump and drive at operating temperature:

Table 6: Cold settings for parallel vertical alignment

If the operating temperature of the pumped liquid is...	Then, set the driver shaft parallel vertical alignment...
50°F (10°C)	0.002 in. (0.05 mm) lower
150°F (65°C)	0.001 in. (0.03 mm) higher
250°F (120°C)	0.005 in. (0.12 mm) higher

Perform parallel alignment for a horizontal correction

A unit is in parallel alignment when the parallel indicator (P) does not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart at the operating temperature.

1. Set the parallel alignment indicator to zero on the left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicator through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator reading.

When the reading value is...	Then...
Negative	The driver coupling half is to the left of the pump coupling half.
Positive	The driver coupling half is to the right of the pump coupling half.

4. Slide the driver carefully in the appropriate direction.

NOTICE: Make sure to slide the driver evenly. Failure to do so can negatively affect horizontal angular correction.

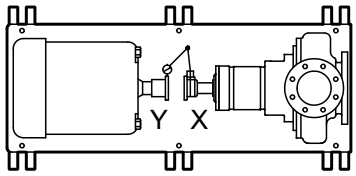


Figure 11: Top view of an incorrect horizontal alignment

5. Repeat the previous steps until the permitted reading value is achieved.

   Maximum permitted value for parallel alignment:

   - 0.002 in. (0.05 mm) total indicated runout at operating temperature

Perform complete alignment for a vertical correction

A unit is in complete alignment when both the angular indicator (A) and the parallel indicator (P) do not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart.

1. Set the angular and parallel dial indicators to zero at the top-center position (12 o'clock) of the driver coupling half (Y).
2. Rotate the indicators to the bottom-center position (6 o'clock).
3. Record the indicator readings.
4. Make corrections according to the separate instructions for angular and parallel alignment until you obtain the permitted reading values.

Maximum permitted value for angular alignment:

- 0.002 in. (0.05 mm) total indicated runout at operating temperature

Maximum permitted value for parallel alignment:

- 0.002 in. (0.05 mm) total indicated runout at operating temperature

When the procedure is complete, both the angular and parallel alignment must meet the permitted tolerances.

Perform complete alignment for a horizontal correction

A unit is in complete alignment when both the angular indicator (A) and the parallel indicator (P) do not vary by more than 0.002 in. (0.05 mm) as measured at four points 90° apart.

1. Set the angular and parallel dial indicators to zero at the left side of the driver coupling half (Y), 90° from the top-center position (9 o'clock).
2. Rotate the indicators through the top-center position to the right side, 180° from the start position (3 o'clock).
3. Record the indicator readings.
4. Make corrections according to the separate instructions for angular and parallel alignment until you obtain the permitted reading values.

   Maximum permitted value for angular alignment:

   - 0.002 in. (0.05 mm) total indicated runout at operating temperature

   Maximum permitted value for parallel alignment:

   - 0.002 in. (0.05 mm) total indicated runout at operating temperature

When the procedure is complete, both the angular and parallel alignment must meet the permitted tolerances.

Grout the baseplate

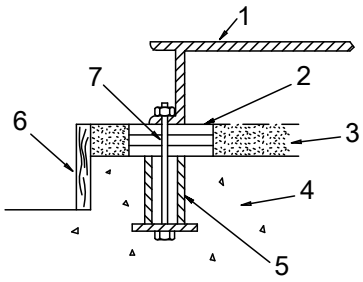
Required equipment:

- Cleaners: Do not use an oil-based cleaner because the grout will not bond to it. See the instructions provided by the grout manufacturer.
- Grout: Non-shrink grout is recommended.

1. Clean all the areas of the baseplate that will come into contact with the grout.
2. Build a dam around the foundation.
3. Thoroughly wet the foundation that will come into contact with the grout.
4. Pour grout through the grout hole into the baseplate up to the level of the dam.

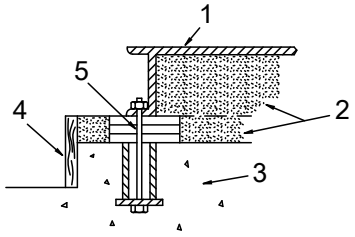
   When you pour the grout, remove air bubbles from it by using one of these methods:

   - Puddle with a vibrator.
   - Pump the grout into place.
5. Allow the grout to set.



1. Baseplate
2. Shims or wedges
3. Grout
4. Foundation
5. Sleeve
6. Dam
7. Bolt

6. Fill the remainder of the baseplate with grout, and allow the grout to set for at least 48 hours.



1. Baseplate
2. Grout
3. Foundation
4. Dam
5. Bolt

7. Tighten the foundation bolts.
8. Recheck the alignment.

Piping checklists

Fastening

WARNING:

- Only use fasteners of the proper size and material.
- Replace all corroded fasteners.
- Make sure that all fasteners are properly tightened and that there are no missing fasteners.

General piping checklist

Precautions

WARNING:

- The heating of water and other fluids causes volumetric expansion. The associated forces can cause the failure of system components and the release of high-temperature fluids. In order to prevent this, install properly sized and located compression tanks and pressure-relief valves. Failure to follow these instructions can result in serious personal injury or death, or property damage.

CAUTION:

- Never draw piping into place by using force at the flanged connections of the pump. This can impose dangerous strains on the unit and cause misalignment between the pump and driver. Pipe strain adversely affects the operation of the pump, which results in physical injury and damage to the equipment.
- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

NOTICE:

Flange loads from the piping system, including those from the thermal expansion of the piping, must not exceed the limits of the pump. Deformation can result in contact with rotating parts, which can result in excess heat generation, sparks, and premature failure.

Piping guidelines

Guidelines for piping are given in the Hydraulic Institute Standards available from the Hydraulic Institute at 9 Sylvan Way, Parsippany, NJ 07054-3802. You must review this document before you install the pump.

Checklist

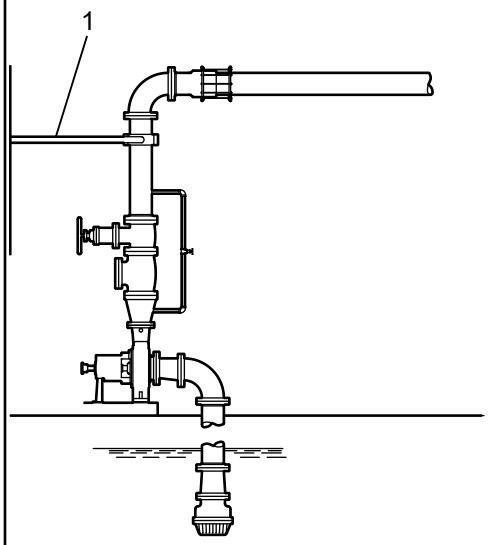
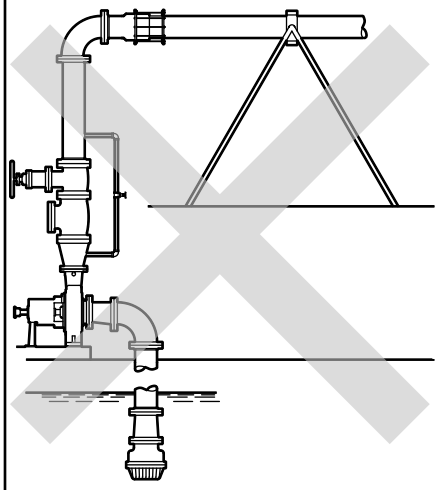
Check	Explanation/comment	Checked
Check that all piping is supported independently of, and lined up naturally with, the pump flange. See Alignment criteria for pump flanges.	This helps to prevent: • Strain on the pump • Misalignment between the pump and the drive unit • Wear on the pump bearings and the coupling • Wear on the pump bearings, seal, and shafting If an isolation base is used, then use flexible piping on the discharge and suction connections.	
Check that only necessary fittings are used.	This helps to minimize friction losses.	
Do not connect the piping to the pump until: • The grout for the baseplate or sub-base becomes hard. • The hold-down bolts for the pump and the driver are tightened.	—	
Make sure that all the piping joints and fittings are airtight.	This prevents air from entering the piping system or leaks that occur during operation. If the pump housing has threaded connections, then use a Teflon tape sealer or a high-quality thread sealant.	
If the pump handles corrosive fluids, make sure that the piping allows you to flush out the liquid before you remove the pump.	—	
If the pump handles liquids at elevated temperatures, make sure that the expansion loops and joints are properly installed.	This helps to prevent misalignment due to linear expansion of the piping. This helps to prevent misalignment due to thermal expansion of the piping.	

Alignment criteria for pump flanges

Type	Criteria
Axial	The flange gasket thickness is ±0.03 in. (0.8 mm).

Type	Criteria
Parallel	Align the flange to be within 0.001 in./in. to 0.03 in./in. (0.025 mm/mm to 0.8 mm/mm) of the flange diameter.
Concentric	You can easily install the flange bolts by hand.

Example: Installation for expansion

Correct	Incorrect
 1. Expansion loop/joint	

Suction-piping checklist

Performance curve reference

CAUTION:

Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side. This action can result in decreased performance, unexpected heat generation, and equipment damage.

Net positive suction head available ($NPSH_A$) must always exceed NPSH required ($NPSH_R$) as shown on the published performance curve of the pump.

If a suction lift over 10 ft. (3 m) and a liquid temperature higher than 120°F (49°C) are required, then read the pump performance curve for the $NPSH_R$.

Suction-piping checks

Check	Explanation/comment	Checked
Flush all suction piping before you connect it to the pump.	This reduces the risk of pump operation problems.	
Check that the distance between the inlet flange of the pump and the closest elbow is at least two pipe diameters.	This minimizes the risk of cavitation in the suction inlet of the pump due to turbulence. See the Example sections for illustrations.	
Check that elbows in general do not have sharp bends.	See the Example sections for illustrations.	
Check that the suction piping is one or two sizes larger than the suction inlet of the pump. Install an eccentric reducer between the pump inlet and the suction piping.	The suction piping must never have a smaller diameter than the suction inlet of the pump.	

Check	Explanation/comment	Checked
	See the Example sections for illustrations.	
Check that the eccentric reducer at the suction flange of the pump has the following properties: • Sloping side down • Horizontal side at the top	See the example illustrations.	
If suction strainers or suction bells are used, check that they are at least three times the area of the suction piping.	Suction strainers help to prevent clogging. Mesh holes with a minimum diameter of 1/16 in. (1.6 mm) are recommended.	
If more than one pump operates from the same liquid source, check that separate suction-piping lines are used for each pump.	This recommendation helps you to achieve a higher pump performance.	
If necessary, make sure that the suction piping includes a drain valve and that it is correctly installed.	—	

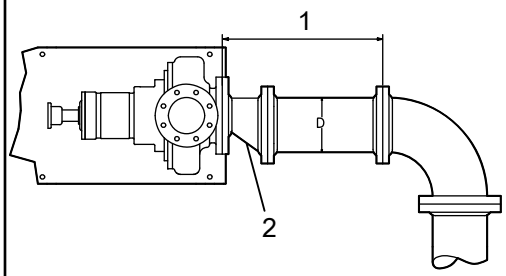
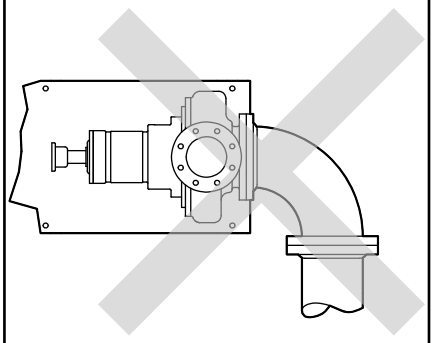
Liquid source below the pump

Check	Explanation/comment	Checked
Make sure that the suction piping is free from air pockets.	This helps to prevent the occurrence of air and cavitation in the pump inlet.	
Check that the suction piping slopes upwards from the liquid source to the pump inlet.	—	
Check that all joints are air-tight.	—	
If the pump is not self-priming, check that a device for priming the pump is installed.	Use a foot valve with a diameter that is at least equivalent to the diameter of the suction piping.	

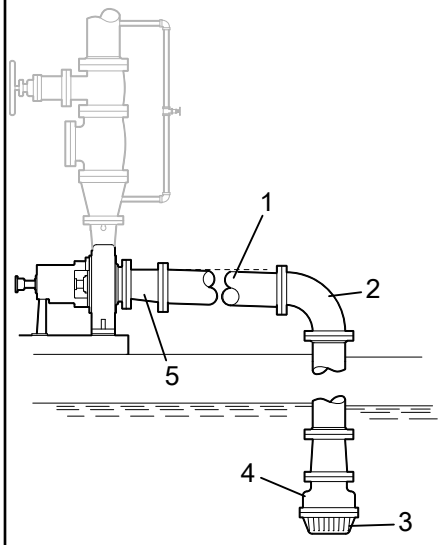
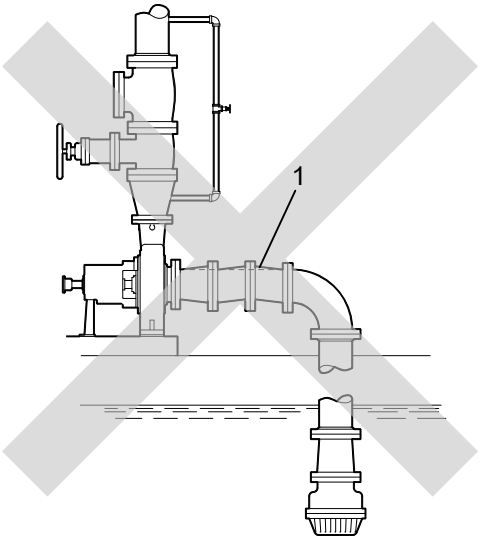
Liquid source above the pump

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the suction piping at a distance of at least two times the pipe diameter from the suction inlet.	This permits you to close the line during pump inspection and maintenance. Do not use the isolation valve to throttle the pump. Throttling can cause these problems: • Loss of priming • Excessive temperatures • Damage to the pump • Voiding the warranty	
Make sure that the suction piping is free from air pockets.	This helps to prevent the occurrence of air and cavitation in the pump inlet.	
Check that the piping is level or slopes downward from the liquid source.	—	
Make sure that no part of the suction piping extends below the suction flange of the pump.	—	
Make sure that the size of the entrance from the supply is one or two sizes larger than the suction pipe.	—	
Make sure that the suction piping is adequately submerged below the surface of the liquid source.	This prevents air from entering the pump through a suction vortex.	

Example: Elbow close to the pump suction inlet

Correct	Incorrect
The correct distance between the inlet flange of the pump and the closest elbow is at least two pipe diameters.  1. Enough distance to prevent cavitation 2. Eccentric reducer with a level top	

Example: Suction piping equipment

Correct	Incorrect
 1. Suction pipe sloping upwards from liquid source 2. Long-radius elbow 3. Strainer 4. Foot valve 5. Eccentric reducer with a level top	 1. Air pocket, because the eccentric reducer is not used and because the suction piping does not slope gradually upward from the liquid source

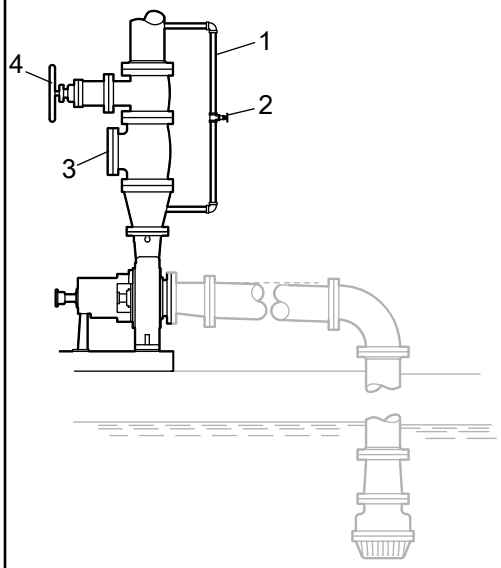
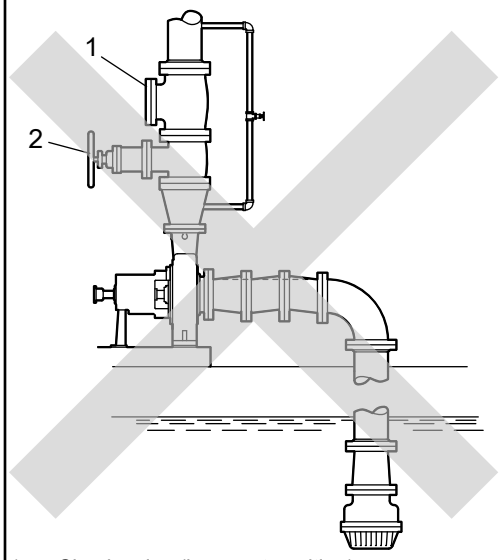
Discharge piping checklist

Checklist

Check	Explanation/comment	Checked
Check that an isolation valve is installed in the discharge line.	The isolation valve is required for: • Priming • Regulation of flow • Inspection and maintenance of the pump See Example: Discharge piping equipment for illustrations.	
Check that a check valve is installed in the discharge line, between the isolation valve and the pump discharge outlet.	The location between the isolation valve and the pump allows inspection of the check valve.	

Check	Explanation/comment	Checked
	The check valve prevents damage to the pump and seal due to the back flow through the pump, when the drive unit is shut off. It is also used to restrain the liquid flow. See Example: Discharge piping equipment for illustrations.	
If increasers are used, check that they are installed between the pump and the check valve.	See Example: Discharge piping equipment for illustrations.	
If quick-closing valves are installed in the system, check that cushioning devices are used.	This protects the pump from surges and water hammer.	

Example: Discharge piping equipment

Correct	Incorrect
 1. Bypass line 2. Shut-off valve 3. Check valve 4. Discharge isolation valve	 1. Check valve (incorrect position) 2. The isolation valve should not be positioned between the check valve and the pump.

Final piping checklist

WARNING:

A build-up of gases within the pump, sealing system, or process piping system may result in an explosive environment. Make sure the process piping system, pump and sealing system are properly vented prior to operation.

Check	Explanation/comment	Checked
Check that the shaft rotates smoothly.	Rotate the shaft by hand. Make sure there is no rubbing that can lead to excess heat generation or sparks.	
Re-check the alignment to make sure that pipe strain has not caused any misalignment.	If pipe strain exists, then correct the piping.	

Commissioning, Startup, Operation, and Shutdown

Preparation for startup

WARNING:

- Failure to follow these precautions before you start the unit will lead to serious personal injury and equipment failure.
- Do not operate the pump below the minimum rated flows or with the suction or discharge valves closed. These conditions can create an explosive hazard due to vaporization of pumped fluid and can quickly lead to pump failure and physical injury.
- Never operate the pump without the coupling guard correctly installed.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.
- When installing in a potentially explosive environment, make sure that the motor is properly certified.

Precautions

NOTICE:

- Verify the driver settings before you start any pump.
- Make sure that the warm-up rate does not exceed 2.5°F (1.4°C) per minute.

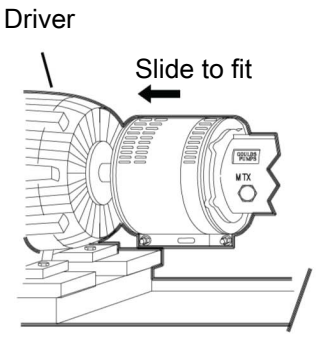
You must follow these precautions before you start the pump:

- Flush and clean the system thoroughly to remove dirt or debris in the pipe system in order to prevent premature failure at initial startup.
- Bring variable-speed drivers to the rated speed as quickly as possible.
- Run a new or rebuilt pump at a speed that provides enough flow to flush and cool the close-running surfaces of the stuffing-box bushing.
- If temperatures of the pumped fluid will exceed 200°F (93°C), then warm up the pump prior to operation. Circulate a small amount of fluid through the pump until the casing temperature is within 100°F (38°C) of the fluid temperature.

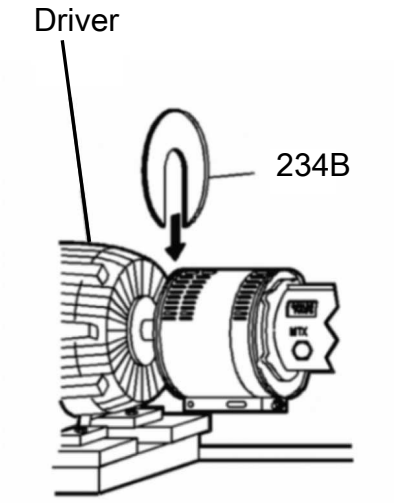
At initial startup, do not adjust the variable-speed drivers or check for speed governor or over-speed trip settings while the variable-speed driver is coupled to the pump. If the settings have not been verified, then uncouple the unit and refer to instructions supplied by the driver manufacturer.

Remove the coupling guard

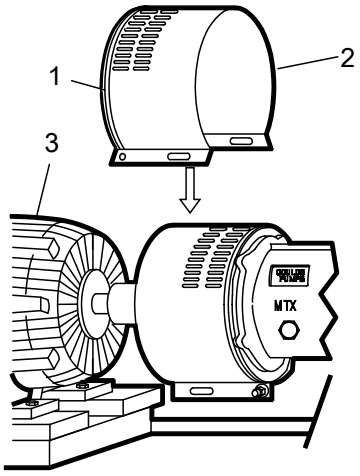
1. Remove the nut, bolt, and washers from the slotted hole in the center of the coupling guard.
2. Slide the driver half of the coupling guard toward the pump.



3. Remove the nut, bolt, and washers from the driver half of the coupling guard.
4. Remove the driver-side end plate.



5. Remove the driver half of the coupling guard:
   a) Slightly spread the bottom apart.
   b) Lift upwards.

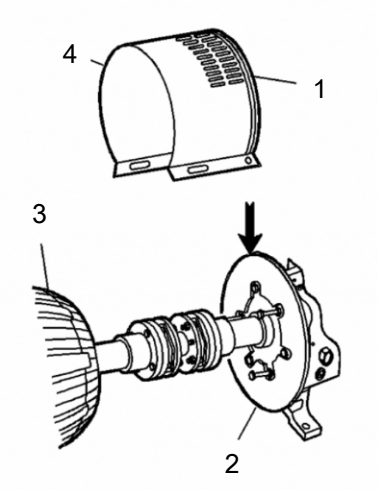


1. Annular groove
2. Driver half of the coupling guard
3. Driver

6. Remove the remaining nut, bolt, and washers from the pump half of the coupling guard.

It is not necessary to remove the end plate from the pump side of the bearing housing. You can access the bearing-housing tap bolts without removing this end plate if maintenance of internal pump parts is necessary.

7. Remove the pump half of the coupling guard:
   a) Slightly spread the bottom apart.
   b) Lift upwards.



1. Annular groove
2. Pump-side end plate
3. Driver
4. Pump half of the coupling guard

Check the rotation

WARNING:

- Operating the pump in reverse rotation can result in the contact of metal parts, heat generation, and breach of containment.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

This procedure only applies to the frame-mounted pumps.

1. Lock out power to the driver.
2. Make sure that the coupling hubs are fastened securely to the shafts.
3. Make sure that the coupling spacer is removed.

   The pump ships with the coupling spacer removed.
4. Unlock power to the driver.
5. Make sure that everyone is clear, and then jog the driver long enough to determine that the direction of rotation corresponds to the arrow on the bearing housing, or close-coupled frame.
6. Lock out power to the driver.

Couple the pump and driver

WARNING:

Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

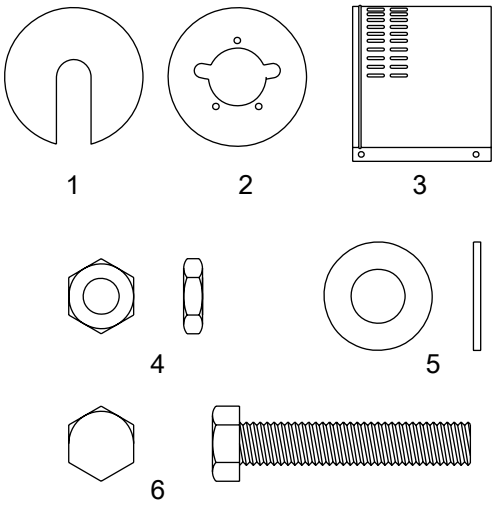
Couplings must have proper certification to be used in an ATEX classified environment. Use the instructions from the coupling manufacturer in order to lubricate and install the coupling.

Install the coupling guard

WARNING:

- Never operate a pump without a properly installed coupling guard. Personal injury will occur if you run the pump without a coupling guard.
- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- The coupling used in an Ex-classified environment must be properly certified and must be constructed from a non-sparking material.

Required parts:



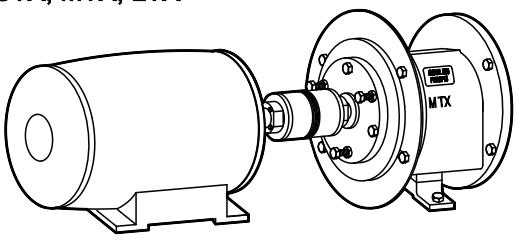
1. End plate, drive end
2. End plate, pump end
3. Guard half, 2 required
4. 3/8-16 nut, 3 required
5. 3/8 in. washer
6. 3/8-16 x 2 in. hex head bolt, 3 required

1. De-energize the motor, place the motor in a locked-out position, and place a caution tag at the starter that indicates the disconnect.
2. Put the pump-side end plate in place.

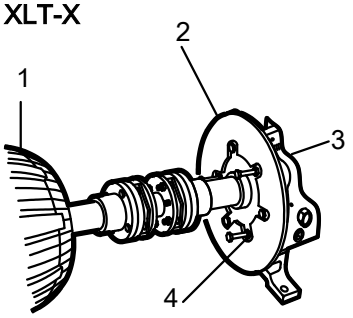
   If the pump-side end plate is already in place, make any necessary coupling adjustments and then proceed to the next step.

If the pump size is...	Then...
STX, MTX, LTX	Align the pump-side end plate to the bearing frame. You do not need to adjust the impeller.

STX, MTX, LTX

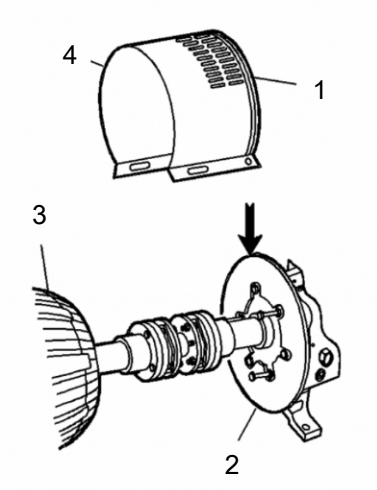


XLT-X



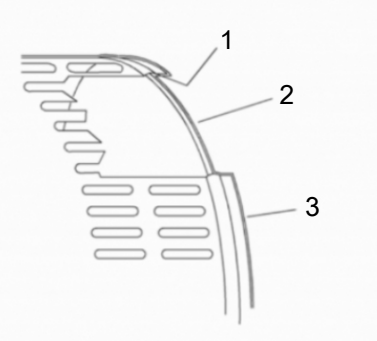
1. Driver
2. Pump end plate
3. Bearing housing
4. Jam nut

3. Put the pump-half of the coupling guard in place:
   a) Slightly spread the bottom apart.
   b) Place the coupling guard half over the pump-side end plate.



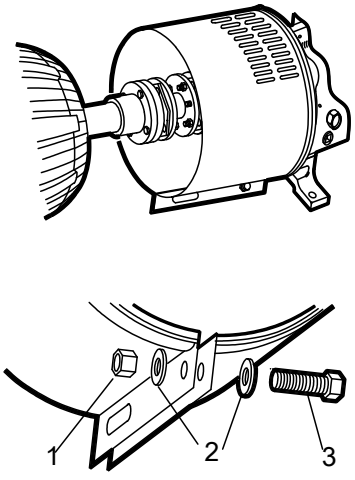
1. Annular groove
2. Pump-side end plate
3. Driver
4. Pump half of the coupling guard

The annular groove in the coupling guard half must fit around the end plate.



1. Annular groove
2. End plate (pump end)
3. Guard half

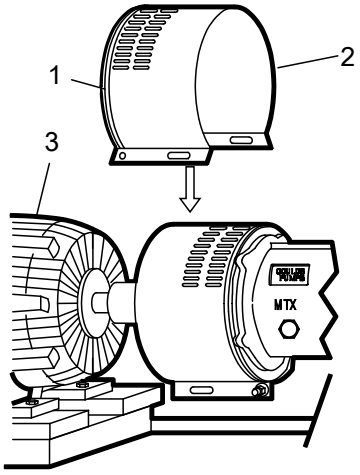
4. Use a bolt, a nut, and two washers to secure the coupling guard half to the end plate. Tighten securely.



1. Nut
2. Washer
3. Bolt

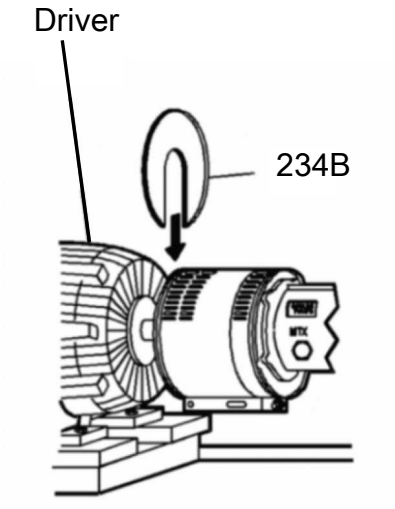
5. Put the driver half of the coupling guard in place:
   a) Slightly spread the bottom apart.

b) Place the driver half of the coupling guard over the pump half of the coupling guard.
The annular groove in the coupling guard half must face the motor.

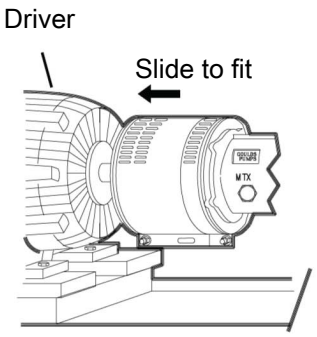


1. Annular groove
2. Driver half of the coupling guard
3. Driver

6. Place the driver-side end plate over the motor shaft.



7. Place the driver-side end plate in the annular groove of the driver-half of the coupling guard.
8. Use a bolt, a nut, and two washers to secure the coupling guard half to the end plate. Hand-tighten only.
   The hole is located on the driver-side of the coupling guard half.
9. Slide the driver-half of the coupling guard towards the motor so that the coupling guard completely covers the shafts and coupling.



10. Use a nut, a bolt, and two washers to secure the coupling guard halves together.
11. Tighten all nuts on the guard assembly.

WARNING:
Never operate the pump without the coupling guard correctly installed.

Bearing lubrication

WARNING:
Pumps are shipped without oil. Oil-lubricated anti-friction bearings must be lubricated at the job site.

These bearing lubrication sections list different pumped-fluid temperatures. If your pump is ATEX certified and your pumped-fluid temperature exceeds the permitted temperature values, then consult your ITT representative.

Lubrication requirements

Pump type	Pump model	Requirements
Close coupled	3298 SP3298 V3298	Close coupled pumps do not have bearings which require lubrication.
Frame mounted	3298 SP3298	• Oil level is measured through the sight glass. • Oil level must not fall below the center of the sight glass. • An increase in level may be noted after startup due to oil circulation within the bearing frame.

Lubricating oil requirements

Quality requirements

Use a high quality turbine oil with rust and oxidation inhibitors.

Lubricating oil requirements

	Bearing temperature below 180°F (82°C)	Bearing temperature above 180°F (82°C)
ISO grade	**ISO viscosity grade 68**	**ISO viscosity grade 100**
Approximate SSU at 100°F (38°C)	300	470
DIN 51517	C68	C100
Kinematic viscosity at 105°F (40°C) mm^2/sec	68	100

Acceptable oil for lubricating bearings

Acceptable lubricants

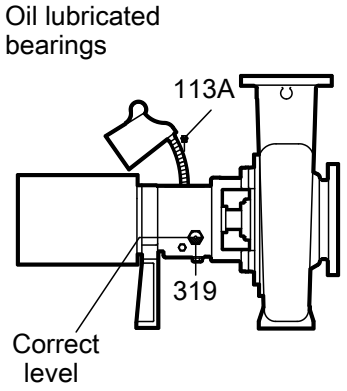
Brand	Lubricant type
Chevron	GTS Oil 68
Exxon	NUTHO H68
Mobil	DTE 26 300 SSU @ 100°F (38°C)
Philips	Mangus Oil 315 MM motor oil SAE 20-20W HDS motor oil SAE 20-20W
Shell	Tellus Oil 68
Gulf	Harmony 68

Lubricate the bearings with oil

Use a high-quality turbine oil with rust and oxidation inhibitors.

1. Remove the fill plug.
2. Fill the bearing frame with oil through the filler connection, which is located on top of the bearing frame.

   Fill the bearing frame with oil until the oil level reaches the middle of the sight glass (319).

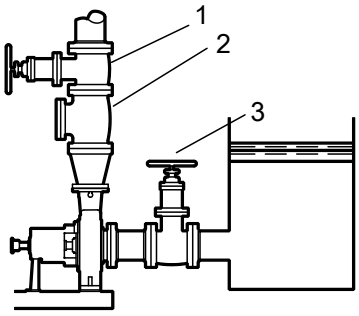


3. Replace the fill plug.

Pump priming

Prime the pump with the suction supply above the pump

1. Slowly open the suction isolation valve.
2. Open the air vents on the suction and discharge piping until the pumped fluid flows out.
3. Close the air vents.



1. Discharge isolation valve
2. Check valve
3. Suction isolation valve

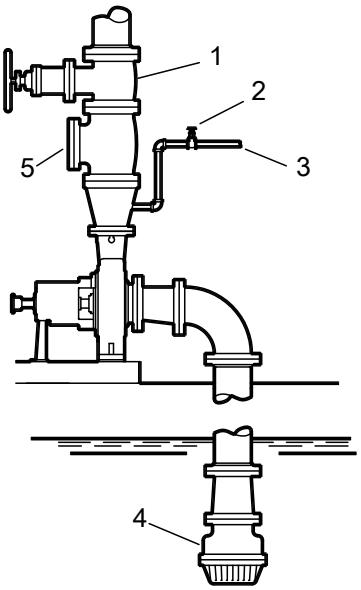
Prime the pump with the suction supply below the pump

Use a foot valve and an outside source of liquid in order to prime the pump. The liquid can come from one of these sources:

- A priming pump
- A pressurized discharge line
- Another outside supply

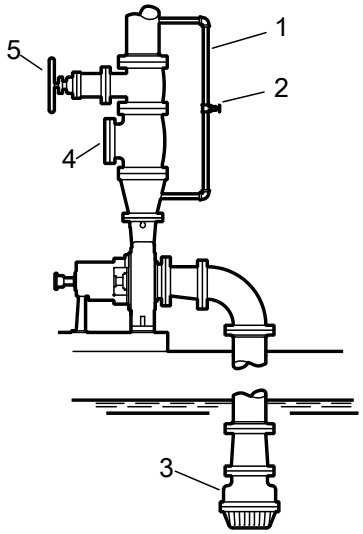
1. Close the discharge isolation valve.
2. Open the air vent valves in the casing.
3. Open the valve in the outside supply line until only liquid escapes from the vent valves.
4. Close the vent valves.
5. Close the outside supply line.

This illustration is an example of priming the pump with a foot valve and an outside supply:



1. Discharge isolation valve
2. Shutoff valve
3. From outside supply
4. Foot valve
5. Check valve

This illustration is an example of priming the pump with a foot valve using a bypass around the check valve:



1. By-pass line
2. Shutoff valve
3. Foot valve
4. Check valve
5. Discharge isolation valve

Other methods of priming the pump

You can also use these methods in order to prime the pump:

- Prime by ejector
- Prime by automatic priming pump

Start the pump

WARNING:

Continuous operation against a closed discharge valve can vaporize liquid. This condition can cause an explosion due to confined vapor that is under high pressure and temperature.

CAUTION:

- Immediately observe the pressure gauges. If discharge pressure is not quickly attained, stop the driver, reprime, and attempt to restart the pump.
- Observe the pump for vibration levels, bearing temperature, and excessive noise. If normal levels are exceeded, shut down the pump and resolve the issue.
- Continuous operation against a closed discharge valve will cause the pump to overheat. Overheating the magnetic drive assembly will weaken or ruin the magnets.

Before you start the pump, you must perform these tasks:

- Open the suction valve.
- Open any recirculation or cooling lines.

1. Fully close or partially open the discharge valve, depending on system conditions.
2. Start the driver.
3. Slowly open the discharge valve until the pump reaches the desired flow.
4. Immediately check the pressure gauge to ensure that the pump quickly reaches the correct discharge pressure.

5. If the pump fails to reach the correct pressure, perform these steps:
   a) Stop the driver.
   b) Prime the pump again.
   c) Restart the driver.
6. Monitor the pump while it is operating:
   a) Check the pump for bearing temperature, excessive vibration, and noise.
   b) If the pump exceeds normal levels, then shut down the pump immediately and correct the problem.

      A pump can exceed normal levels for several reasons. See Troubleshooting for information about possible solutions to this problem.
7. Repeat steps 5 and 6 until the pump runs properly.

Minimum continuous recommended flow

Group	Pump size	60 Hertz			50 Hertz		
		GPM			m3/hr		
		3600	1800	1200	3000	1500	1000
3298							
XS	1 x 1.5 - 5	1	0.5	—	0.2	0.1	—
	1½ x 2 - 6	5	3	—	1	0.5	—
S	1 x 1.5 - 6	5	3	2	2	1	0.5
	1 x 1.5 - 8	15	8	4	3	2	1
	1½ x 3 - 7	20	10	6	5	2	1
	2 x 3 - 6	30	15	8	6	3	1
M	1½ x 3 - 8	30	15	8	6	3	1
	2 x 3 - 8	50	9	5	9	2	1
	3 x 4 - 7	80	13	9	18	9	6
	1 x 2 - 10	30	5	3	5	3	2
L	1½ x 3 - 10	60	30	20	11	5	4
	2 x 3 - 10	100	50	33	19	10	6
	3 x 4 - 10G	175	90	60	33	16	11
	3 x 4 - 10H	-	90	30	—	17	3
	4 x 6 - 10	-	475[5]	325[5]	—	95[5]	55[5]
SP3298							
S	1 x 1½ - 6	5	3	2	2	1	0.5
	2 x 3 - 6	30	15	8	6	3	1
V3298							
S	1½ x 2 - 6	5	3	2	2	1	0.5
	1½ 2 - 8	60	30	20	11	7	4
	2 x 3 - 6	60	30	20	11	7	4
M	1½ x 2 - 10	30	5	3	5	0.7	0.5

Group	Pump size	60 Hertz			50 Hertz		
		GPM			m3/hr		
		3600	1800	1200	3000	1500	1000

1. All flows are for a continuous operation of 24 hours a day, seven days a week.
2. These values are based on water with a specific gravity of 1.0 and specific heat of 1.0.
3. You can reliably operate the pumps at lower minimum flows under intermittent operating conditions (less than 15% of the time). Contact ITT for more information.
4. Contact the factory for pump efficiency at minimum flows.
5. You can operate the pump at substantially lower flows with an adequate NPSH margin. Contact ITT for details.

Pump operation precautions

General considerations

WARNING:

- Never operate the pump below the minimum rated flow, when dry, or without prime.

CAUTION:

- Vary the capacity with the regulating valve in the discharge line. Never throttle the flow from the suction side since this can result in decreased performance, unexpected heat generation, and equipment damage.
- Do not overload the driver. Driver overload can result in unexpected heat generation and equipment damage. The driver can overload in these circumstances:
  - The specific gravity of the pumped fluid is greater than expected.
  - The pumped fluid exceeds the rated flow rate.
- Make sure to operate the pump at or near the rated conditions. Failure to do so can result in pump damage from cavitation or recirculation.

Operation at reduced capacity

WARNING:

Never operate any pumping system with a blocked suction and discharge. Operation, even for a brief period under these conditions, can cause confined pumped fluid to overheat, which results in a violent explosion. You must take all necessary measures to avoid this condition.

CAUTION:

- Avoid excessive vibration levels. Excessive vibration levels can damage the bearings, stuffing box or seal chamber, and the mechanical seal, which can result in decreased performance.
- Avoid increased radial load. Failure to do so can cause stress on the shaft and bearings.
- Avoid heat build-up. Failure to do so can cause rotating parts to score or seize.
- Avoid cavitation. Failure to do so can cause damage to the internal surfaces of the pump.

Operation under freezing conditions

NOTICE:

Do not expose an idle pump to freezing conditions. Drain all liquid that is inside the pump and the cooling coils. Failure to do so can cause liquid to freeze and damage the pump.

Temperature ratings

CAUTION:

Do not operate the pump above the rated temperature range of the magnets. This will weaken or ruin the magnets. The rated temperature is 250°F (121°C) for all sizes.

Shut down the pump

WARNING:

The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

1. Slowly close the discharge valve.
2. Shut down and lock the driver to prevent accidental rotation.

Make the final alignment of the pump and driver

WARNING:

- Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.
- Follow shaft alignment procedures in order to prevent catastrophic failure of drive components or unintended contact of rotating parts. Follow the coupling installation and operation procedures from the coupling manufacturer.

You must check the final alignment after the pump and driver are at operating temperature. For initial alignment instructions, see the Installation chapter.

1. Run the unit under actual operating conditions for enough time to bring the pump, driver, and associated system to operating temperature.
2. Shut down the pump and the driver.
3. Remove the coupling guard.

   See Remove the coupling guard in the Maintenance chapter.
4. Check the alignment while the unit is still hot.

   See Pump-to-driver alignment in the Installation chapter.
5. Reinstall the coupling guard.
6. Restart the pump and driver.

Maintenance

Maintenance schedule

Maintenance inspections

A maintenance schedule includes these types of inspections:

- Routine maintenance
- Routine inspections
- Three-month inspections
- Annual inspections

Shorten the inspection intervals appropriately if the pumped fluid is abrasive or corrosive or if the environment is classified as potentially explosive.

Routine maintenance

Perform these tasks whenever you perform routine maintenance:

- Lubricate the bearings.
- Inspect the seal.

Routine inspections

Perform these tasks whenever you check the pump during routine inspections:

- Check the level and condition of the oil through the sight glass on the bearing frame.
- Check for unusual noise, vibration, and bearing temperatures.
- Check the pump and piping for leaks.
- Analyze the vibration.
- Inspect the discharge pressure.

Three-month inspections

Perform these tasks every three months:

- Check that the foundation and the hold-down bolts are tight.
- Check the shaft alignment, and realign as required.

Annual inspections

Perform these inspections one time each year:

- Check the pump capacity.
- Check the pump pressure.
- Check the pump power.

If the pump performance does not satisfy your process requirements, and the process requirements have not changed, then perform these steps:

1. Disassemble the pump.
2. Inspect it.
3. Replace worn parts.

Bearing maintenance

Lubrication schedule

Type of bearing	First lubrication	Lubrication intervals
Oil lubricated	Change the oil after 200 hours for new bearings.	After the first 200 hours, change the oil every 4000 operating hours or every six months.

Required tools

WARNING:
This pump contains extremely strong magnets. You must use non-magnetic tools and work surfaces.

Non-magnetic tools

- 9/16-inch and 3/4-inch socket wrench
- Non-metallic hammer

Tools

- Long T-handle hex wrench in size 3/16-inch
- 1/2-inch, 9/16-inch, and 3/4-inch sockets
- Socket wrench with a minimum extension of 4 in. (10 cm)
- Screw drivers
- Lip seal driver
- Hammer
- Three 5/16-inch x 2-inch hex capscrews
- Three 5/8-inch x 4-inch hex capscrews

Tool kits

You can use these available tool kits in order to ease the assembly and disassembly of these pumps:

Group	Kit number	Optional tools	
		Tool number	Description
XS	R298TK04	B03309A	1 x 1½-5 bearing spider installation driver
		B04370A	1½ x2-6 bearing spider installation driver
		B03310A	Radial bearing installation tool
		A06872A	Bearing press support tool
S	R298TK01	B02496A	Bearing spider installation driver
		B02497A	Radial bearing installation tool
M	R298TK02	B03147A	Bearing spider installation driver
		B03148A	Bearing spider installation driver
		B03149A	Radial bearing installation tool
		B03189A	Magnet assembly/disassembly guide rods
L	R298TK03	B03191A	Bearing spider installation driver
		B03175A	Radial bearing installation tool
		B03149A	Radial bearing installation tool
		B03189A	Magnetic assembly/disassembly guide rods

Disassembly

Disassembly precautions

WARNING:

- Chemical hazard. You must individually decontaminate each component according to all federal, state, local, and company environmental regulations.
- A build up of gases within the pump, sealing system, or process-piping system can result in an explosive environment within the pump. Make sure that the process piping system, pump, and sealing system are properly vented prior to operation.
- Process fluid leaks can result in an explosive atmosphere. Follow all pump and seal assembly procedures.
- Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, open vent or drain valves, or disconnect the piping.
- Crush hazard. The unit and the components can be heavy. Use proper lifting methods and wear steel-toed shoes at all times.
- The pump can handle hazardous and toxic fluids. Identify the contents of the pump and observe proper decontamination procedures in order to eliminate the possible exposure to any hazardous or toxic fluids. Wear the proper personal protective equipment. Potential hazards include, but are not limited to, high temperature, flammable, acidic, caustic, explosive, and other risks. You must handle and dispose of pumped fluid in compliance with the applicable environmental regulations.

CAUTION:

- You must keep the shop area clean and free of any substances that can contaminate the magnets, such as ferrous metals.
- The magnets in this unit are extremely powerful. Beware of serious injury to fingers and hands. Keep magnetic drive components and magnetic tools apart by a minimum of 3 ft (1 m).

NOTICE:

Use a bench with a non-magnetic work surface such as wood or brass when you work on the pump.

Prepare the pump for disassembly

1. Lock out power to the driver.

WARNING:

Always disconnect and lock out power to the driver before you perform any installation or maintenance tasks. Failure to disconnect and lock out driver power will result in serious physical injury.

2. Shut off all valves that control flow to and from the pump.
3. Drain and flush the pump before you remove it from the piping.
4. Isolate the pump from the system and then flush the pump using a compatible liquid.
5. Disconnect all piping and auxiliary equipment.
6. For the frame-mounted pump, remove the coupling guard and coupling.
7. Remove the casing foot and frame and C-face motor-support foot bolts.
8. Remove the pump from the baseplate.
9. For the frame-mounted pump, drain the oil.
10. Decontaminate the pump:
    a) Connect a clean-flush liquid supply to the discharge nozzle.
    b) Collect the flushed liquid as it drains out of the drain connection.
    c) Flush the pump in order to remove residue.

Disassemble the close-coupled pump

1. For all pumps except the V group, secure the C-face motor support and bearing frame (228) to the workbench.
2. Remove the four bolts (370B) from the C-face motor support and bearing frame (228).

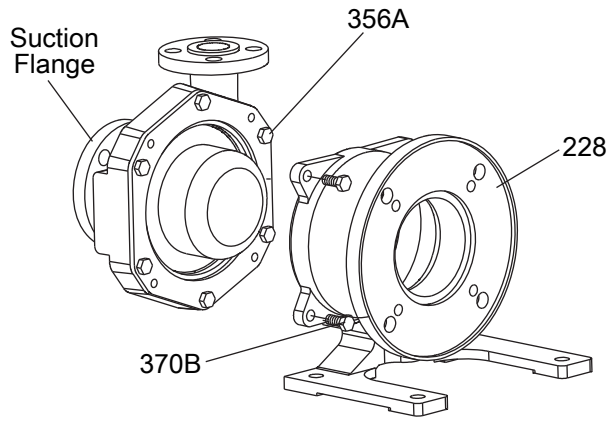


Figure 12: XS group

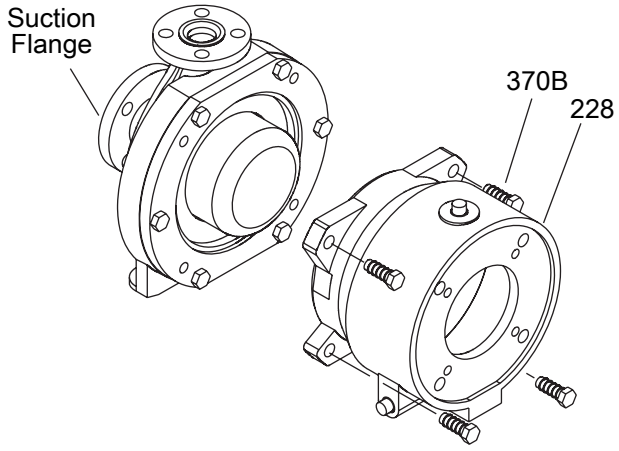


Figure 13: S group

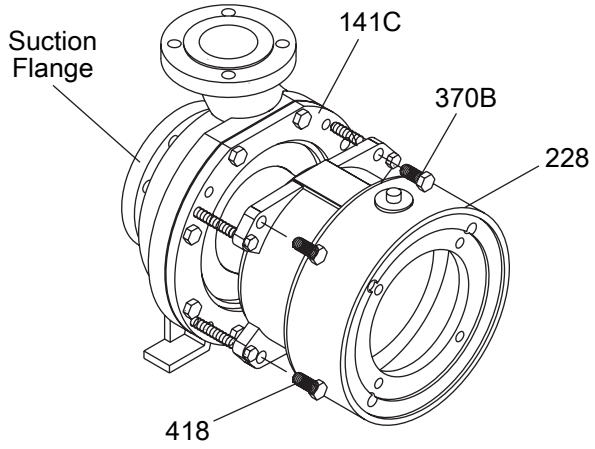


Figure 14: M group

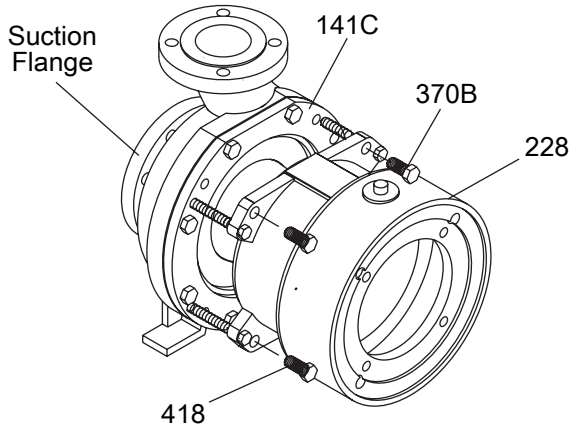


Figure 15: L group

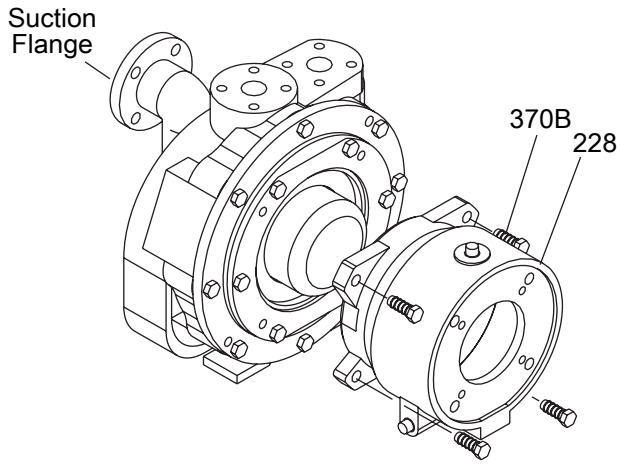


Figure 16: SP group

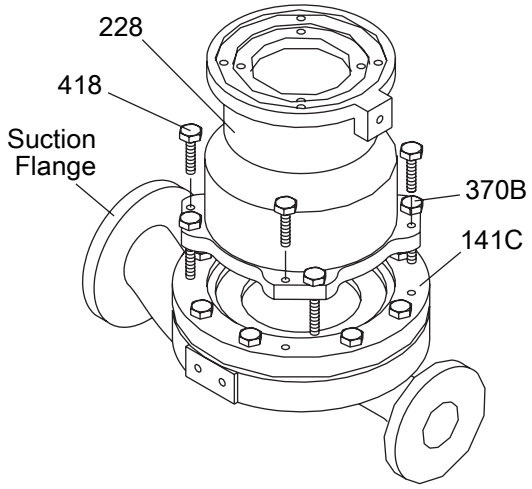


Figure 17: V group

3. For the M and L group pumps, tighten the jacking screws (418) until the gap between the clamp ring (141C) and the C-face motor support and bearing frame is 3.50 in. (8.89 cm).

4. For all pumps except the V group, grasp the suction flange of the casing and pull the casing-liquid end free from the magnet assembly.
5. For the V group, grasp the motor adapter and pull it off of the casing.
6. For all pumps except the SP group, remove the casing bolts (356A).
7. Wrap a piece of emery cloth around the containment shell (750) and secure it with a large hose clamp.

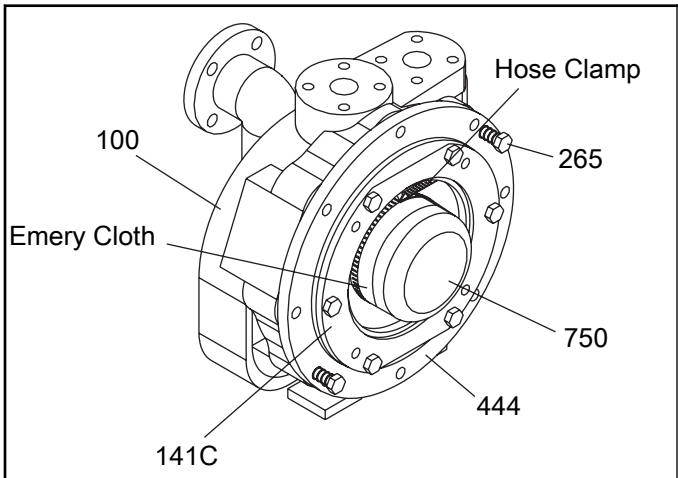


Figure 18: SP group

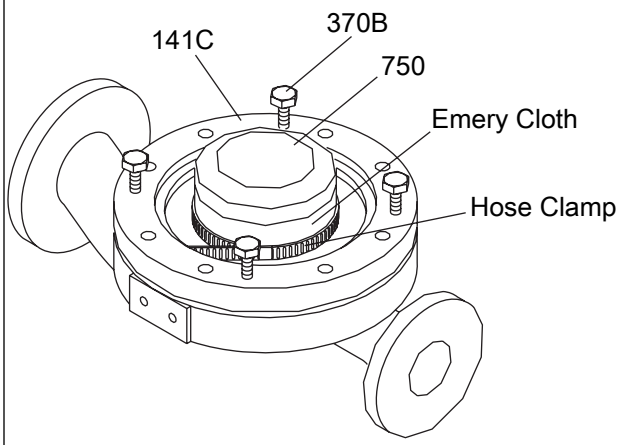


Figure 19: V group

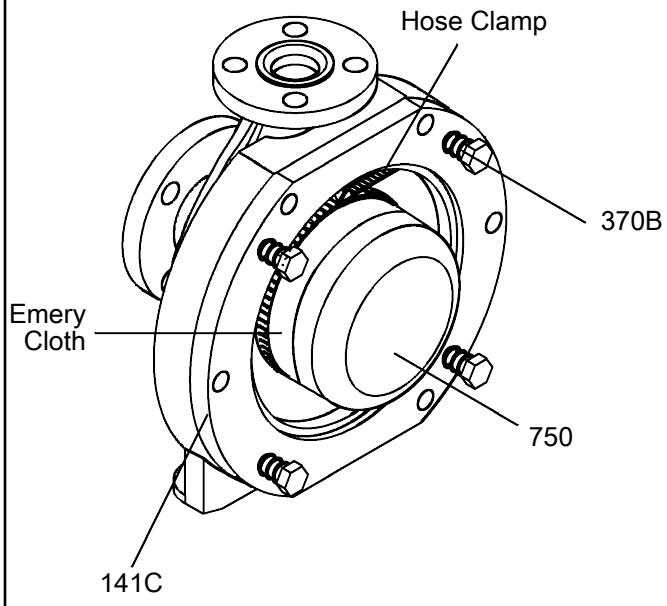


Figure 20: XS, X, S, M, and L groups

8. For the SP group pump, complete these steps:
   a) Thread the casing bolts (372V) into the tapped holes in the backplate (444) and tighten evenly in order to remove the backplate and clamp-ring assembly from the casing (100).
   b) Remove the O-ring (412V) from the backplate and discard it.
   c) Remove the impeller assembly (101) and the clamp ring bolts (356A).

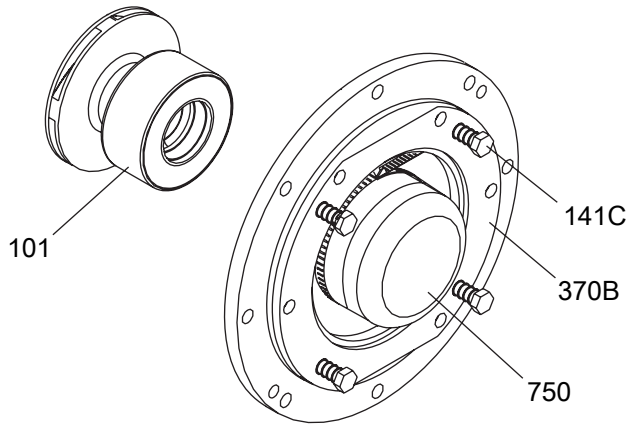


Figure 21: SP group

9. Disassemble the containment shell:
   a) Screw the C-face motor support and bearing frame bolts (370B) into the tapped holes of the clamp ring (141C) and tighten evenly in order to remove the containment shell.
   b) Remove the O-ring (412M) from the containment shell (750) and discard it.
   c) Remove the hose clamp and emery cloth.
10. For all groups except the SP, remove the impeller assembly (101).

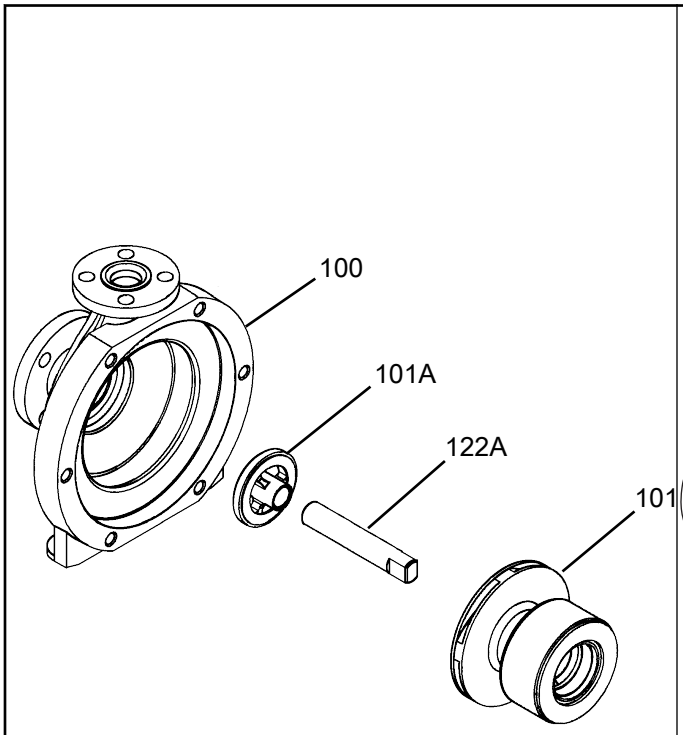


Figure 22: XS, S, M, and L groups

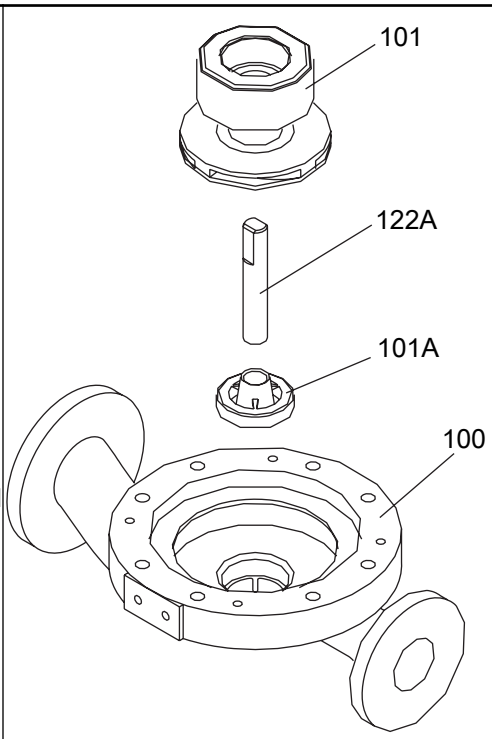


Figure 23: V group

11. Remove the shaft (122A) if replacement is necessary.
12. For the SP group pump, remove the volute insert (100U) from the casing (100).

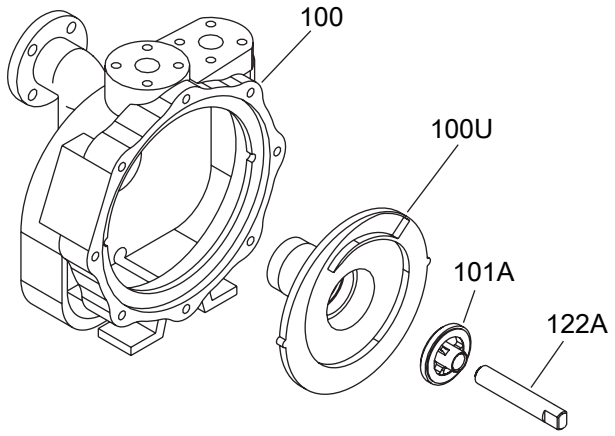


Figure 24: SP group

13. Inspect and replace the bearings, if necessary:
    a) Inspect the bearing spider (101A).
       Press it out through the suction of the casing (100) if replacement is necessary.
    b) Use a bearing tool to press out the radial bearing (197B) from the impeller assembly (101), if replacement is necessary.

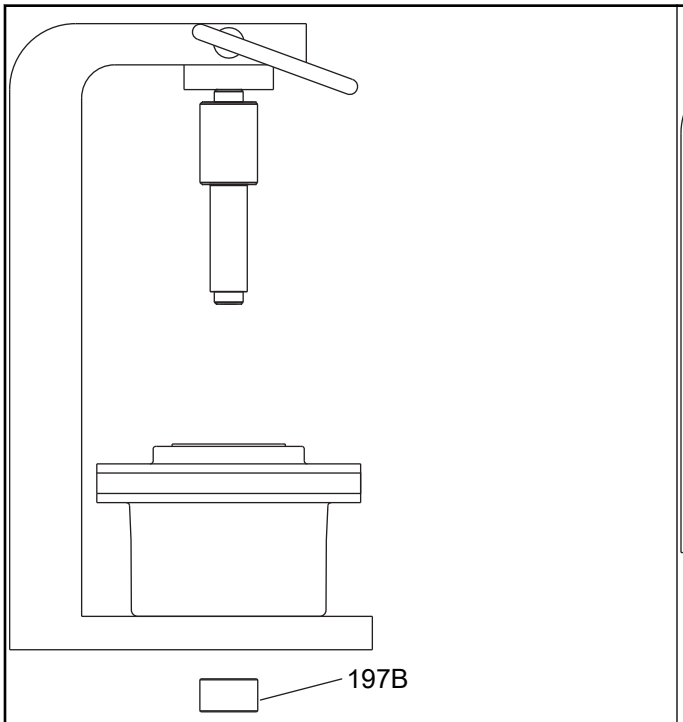


Figure 25: XS group

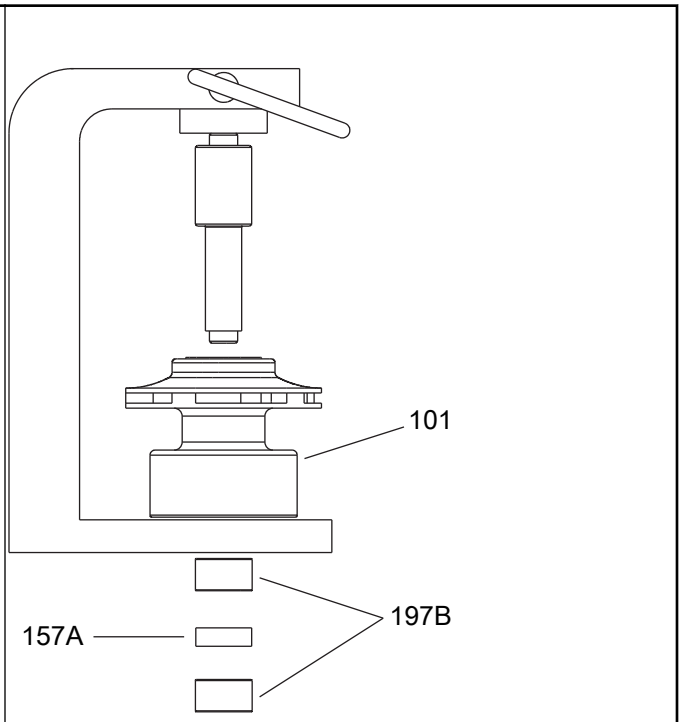
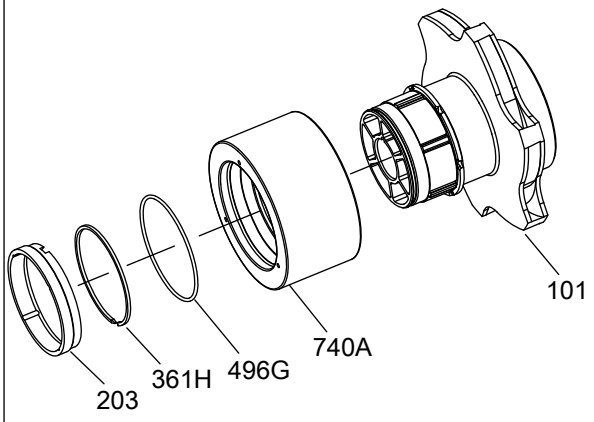


Figure 26: S, M, L, SP, and V groups

14. Inspect and replace these parts as necessary:

Pump group	Step
M and L	Inspect the rear impeller wear ring (203) and remove it if replacement is necessary.

Pump group	Step
L	Remove the retaining ring (361H). Then slide or press the magnet assembly (740A) off the impeller assembly (101).  **Figure 27: L group**
S, M, and SP, and V	Remove the reverse thrust bearing (197C) from the containment shell (750) if replacement is necessary.

15. When replacement of the close-coupled drive magnet assembly (740B) is required, remove and discard the nylok setscrews (222L).

    Use a puller and the 2 - 3/8-inch tapped holes provided in order to remove the magnet assembly from the motor shaft.

Disassemble the frame-mounted pump

1. Place a shaft wrench on the drive shaft (122B) and remove the hex nut (355A).

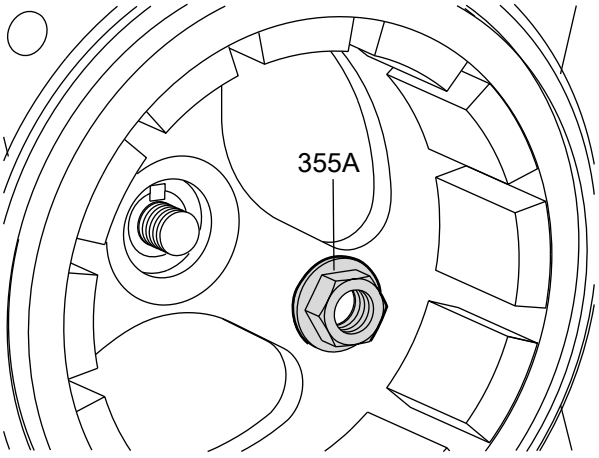


Figure 28: S, L, M, and SP groups

2. Place three capscrews in the jacking screw holes in the magnet assembly (740B).

Group	Capscrew size
S and SP	5/16 in. by 2 in.
M and L	5/8 in. by 4 in.

.

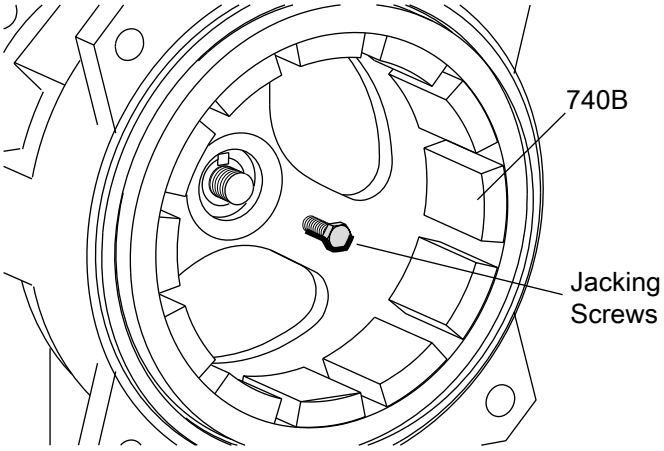


Figure 29: Magnet assembly

3. Tighten the jacking screws evenly and in sequence until you can remove the magnet assembly (740B).
4. Remove the magnet assembly (740B) and place it away from any attracting metals.

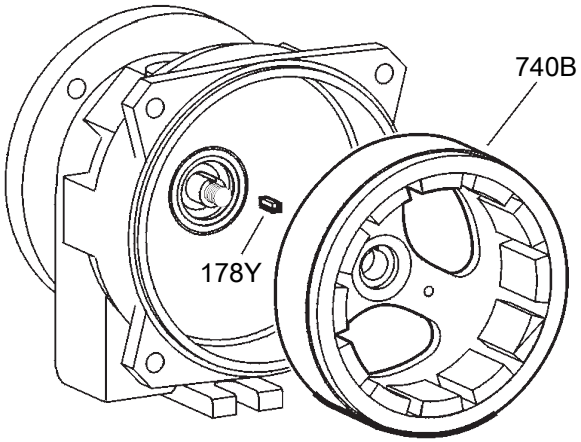


Figure 30: Magnet assembly removal

5. For the L and M group pumps, remove the 5/16 in. wear ring capscrew (372Y) and the wear ring from the bottom of the bearing frame (228).

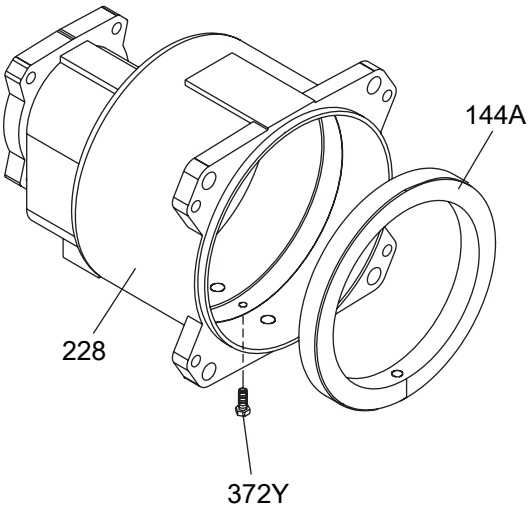


Figure 31: L and M group wear ring removal

6. Remove the bearing end-cover bolts (370C).

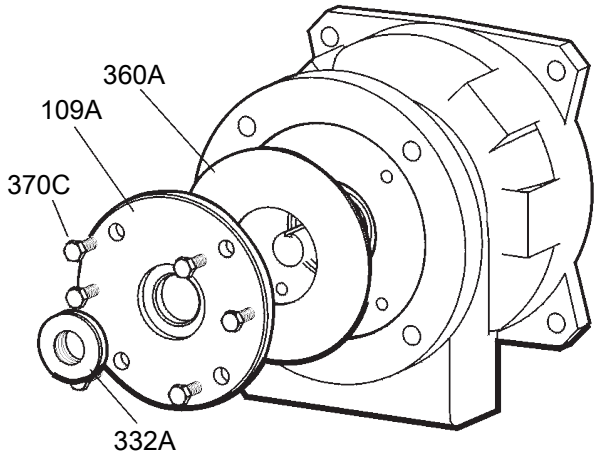


Figure 32: Bearing end-cover bolt removal

7. Install two bearing end-cover bolts (370C) in the jacking screw holes and tighten them evenly in order to remove the bearing end cover (109A).
8. Slide the bearing end cover (109A) backwards.

   The labyrinth oil seal (332A) slides back with the end cover.
9. Remove the labyrinth seal (332A) and the bearing end cover (109A).
10. Remove and discard the gasket (360A).
11. Remove the drive shaft (122B) with ball bearings (112) from the bearing frame (228).

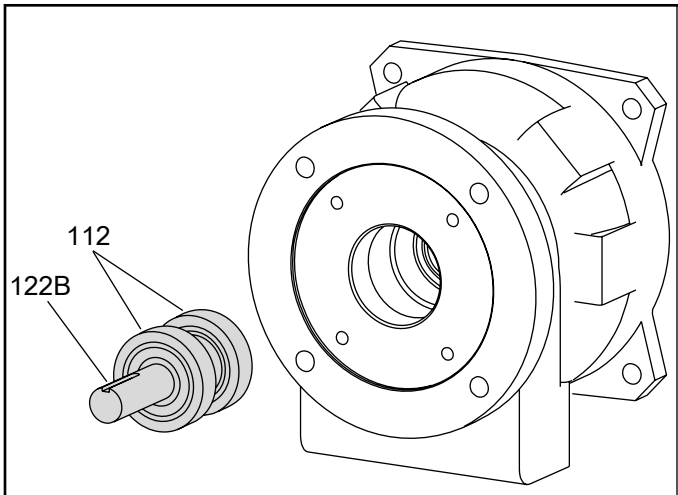


Figure 33: S, M, and SP groups

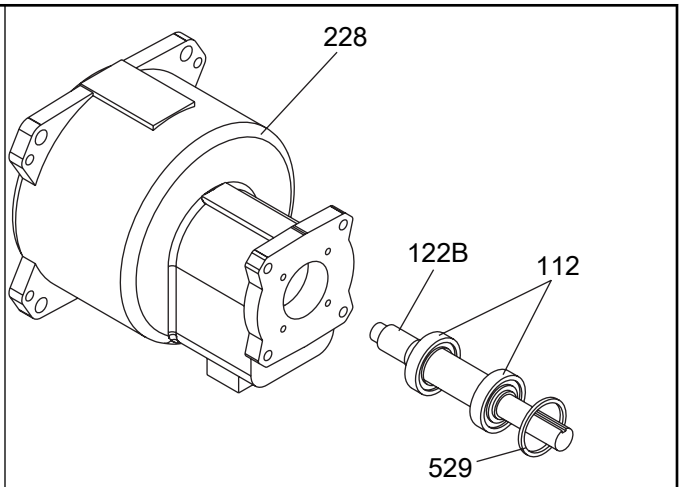


Figure 34: L group

12. Press the bearings (112) off the shaft and inspect them.
13. Remove the lip seal (333D).

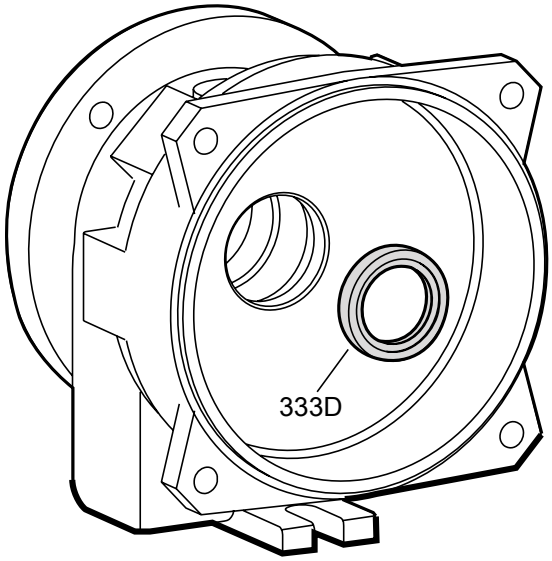


Figure 35: Lip seal removal

Preassembly inspections

Inspect pump parts according to the following criteria before reassembly in order to make sure the pump will run properly. Replace any part that does not meet the required criteria.

Casing

Inspect the casing for excessive wear, abrasive damage, cuts, or a loose liner.

Volute insert (SP3298 only)

Inspect the volute insert for excessive wear, abrasive damage, or cut surfaces.

Spider bearing

Inspect the spider bearing for cracks, chips, or scoring.

Impeller

- Inspect the leading and trailing edges of the vanes for erosion damage.
- Inspect the impeller for cracks and grooves in excess of 0.03 in. (0.75 mm).
- Check the impeller for blocked passages.

Backplate (SP3298 only)

Inspect the backplate for excessive wear, abrasive damage, cuts, or a loose liner.

Back wear ring

Inspect the back wear ring according to the clearances in the Back wear ring clearances table.

Table 7: Back wear ring clearances

Size	New clearance inches (millimeters)	Replace at inches (millimeters)
1 x 1½-5 1½ x 2-6 1 x 1½-6 1 x 1½-7 1 x 1½-8 2 x 3-6 1½ x 3-8 1 x 1½-8	No wear ring	No wear ring

Size	New clearance inches (millimeters)	Replace at inches (millimeters)
3 x 4-7 2 x 3-8 1 x 2-10	0.060 - 0.066 (1.52 - 1.68)	0.090 (2.3)
1½ x 3-10 2 x 3-10 3 x 4-10H 3 x 4-10G 4 x 6-10	0.060 - 0.070 (1.52 - 1.78)	0.094 (2.4)

Radial bearing

- Inspect the bearings for cracks or chips.
- Inspect the diametric bearing clearances:

	New clearance in inches (millimeters)	Replace at inches (millimeters)
Shaft to bearing	0.003 - 0.006 (0.076 - 0.152)	0.012 (0.305)

Reverse and impeller thrust bearings

Inspect these bearings for cracks, chips, or scoring. If the minimum groove height is less than the minimum height recommended, then replace.

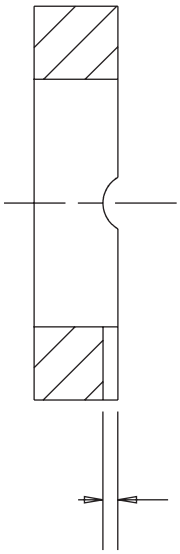


Figure 36: 0.020 in. (0.051 cm) minimum groove height

Stationary shaft

Make sure the stationary shaft is free from cracks and scoring.

Containment shell

- The containment shell must be free from scratches or cracks.
- Replace the containment shell when grooves are in excess of 0.01 in. (0.25 mm) for the outside diameter and 0.030 in. (0.75 mm) for the inside diameter.
- Make sure that the shaft fits snugly in the containment shell.

Magnet assembly

WARNING:

The magnets in this unit are extremely powerful. Beware of serious injury to fingers and hands. Keep magnetic drive components and magnetic tools apart by a minimum of 3 ft (1 m).

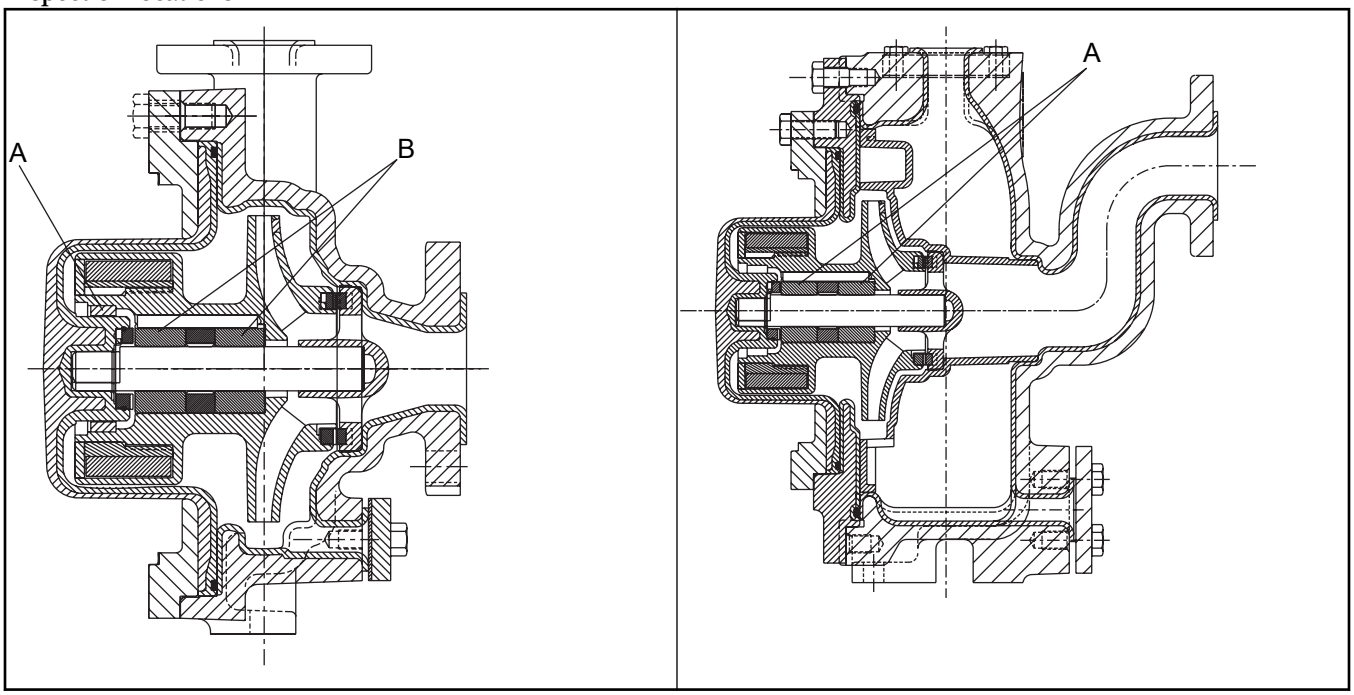
The magnets are extremely brittle. It is normal to have chips (up to 10% of the magnet surface) per MMPA standard no. 0100-90.

- Make sure that magnets are free of major cracks that extend over 50% of the surface and are free of imperfections that create loose particles.
- Replace the magnet assembly if it was exposed to pumped fluid.
- Inspect magnets for proper bonding to the carrier.

Bearing frame - frame-mounted version only

- Inspect the frame and frame foot for cracks.
- Inspect the frame and rub ring for corrosion or pitting if parts have been exposed to pumped fluid.
- Inspect the bearing frame bores. The maximum acceptable bore is:
  - S group: 2.4419 in. (62.024 mm)
  - M and L groups: 2.8353 in. (72.017 mm)
- Inspect the ball bearings for contamination and damage.
- Inspect the bearing end cover for cracks and pits.
- Make sure that the gasket surface is clean.
- Replace the lip seal.
- Inspect the shaft for cracks and scoring.

Inspection locations



Reassembly

Reassembly precautions

WARNING:

Explosion risk. Rubbing could lead to excess heat generation and sparks. Rotate the shaft by hand to make sure it rotates smoothly and that there is no rubbing.

CAUTION:

- The magnets in this unit are extremely powerful. Beware of serious injury to fingers and hands. Keep magnetic drive components and magnetic tools apart by a minimum of 3 ft (1 m).
- Use a non-magnetic socket and wrench.

NOTICE:

- Use caution when you use an hydraulic press because you cannot feel when the bearing hits the bottom of the bore.
- Do not hammer the magnet assembly onto the shaft. This will damage the ball bearings.
- Pressing the radial bearings into the impeller can cause some ETFE to peel. If this occurs, press out the bearings, remove any ETFE filings, and then press the bearings back into the impeller.
- There are several methods you can use to install bearings. The recommended method is to use an induction heater that heats and demagnetizes the bearings.
- You may need to lightly press the shaft with bearings into the bearing frame. It is important that you press the bearings in by putting a sleeve on the inner race of the outboard ball bearing.
- Make sure that the shaft O-ring, grooves, shaft keyways, and keyway in the frame are free of burrs.

Since the bolt pattern for the bearing end cover (109A) is not symmetric, the bearing end cover gasket (360A) and bearing end cover (109A) can only go on one way. This ensures that the oil return slot will always be down.

Reassemble the rotary assembly

1. For the L group, complete these steps:
   a) Install the O-ring (496G) into the driven magnet assembly (740A).
   b) Lubricate the O-ring (496G) with Parker O-ring lube or an equivalent lube.
   c) Press the driven magnet assembly (740A) onto the impeller assembly (101).
   d) Install the retaining ring (361H) into the groove of the impeller assembly (101).

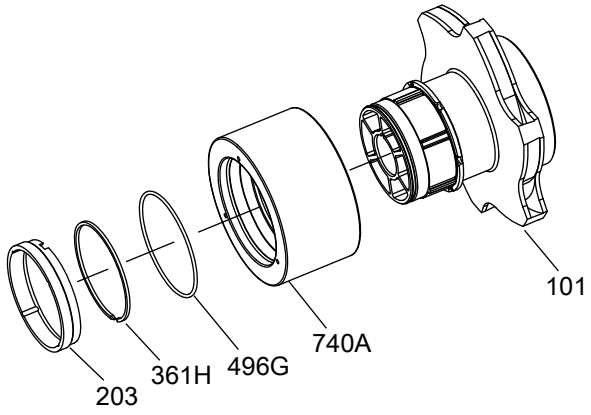


Figure 37: 3298 L group impeller

2. For all groups except XS, install the key:
   a) Slide key (178S) into impeller (101).
   b) Use a center punch to stake the impeller at the end of the key in order to hold the key in place.

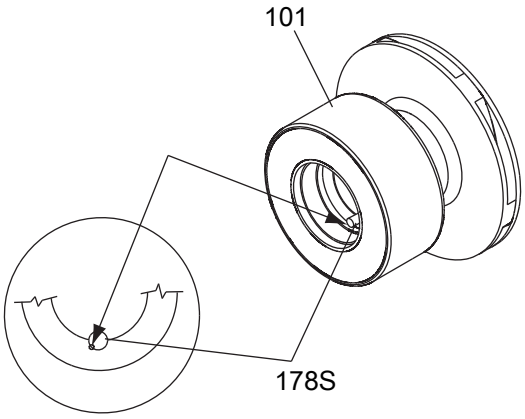


Figure 38: 3298 S, M, and L groups, SP3298, and V3298

3. Install the radial bearing into the impeller:
   a) Lubricate the outside of the radial bearing.
   b) Use the bearing installation tool to press the radial bearing (197B) into the impeller.
   c) Support the impeller with the bearing press support tool.
   d) Line up the keyway in the bearing with the key in the impeller.

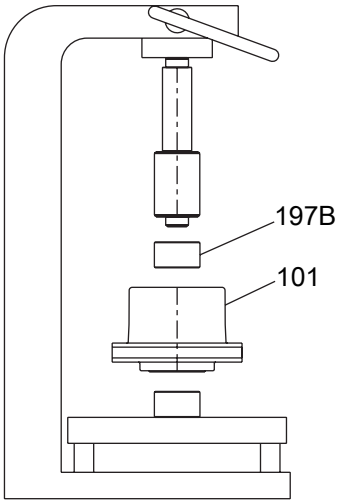


Figure 39: XS group

4. For all groups except XS, slide the bearing spacer (157A) into the impeller and then press the second radial bearing (197B) into the impeller.

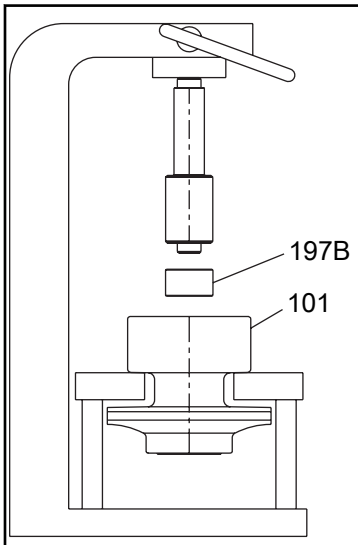


Figure 40: 3298 S and M groups, SP3298, and V3298

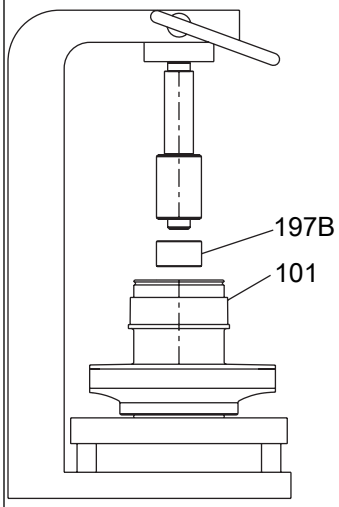


Figure 41: L group

5. For the L group, press the impeller wear ring (203) into the impeller assembly.
6. Turn the impeller over and install the impeller thrust bearing (197D).
   Make sure to align the two slots in the impeller thrust bearing with the two tabs in the impeller.

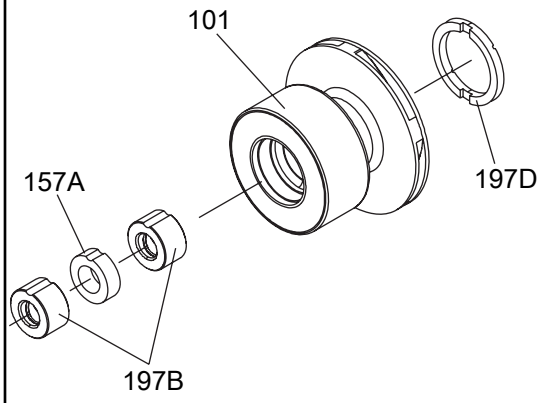


Figure 42: 3298, SP3298, and V3298

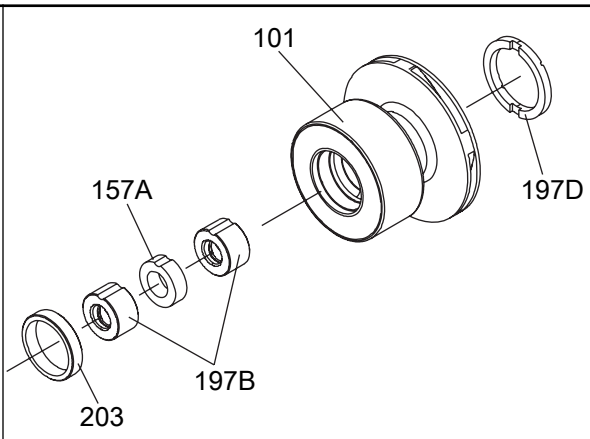


Figure 43: 3298, and V3298 M and L groups

7. For all groups except XS, slide the reverse thrust bearing onto the shaft.
8. Press the shaft (122A) into the containment shell (750).
9. Coat the O-ring (412M) with an O-ring lubricant and insert it in the containment shell (750).
   The lubricant is used to help the O-ring remain in place.

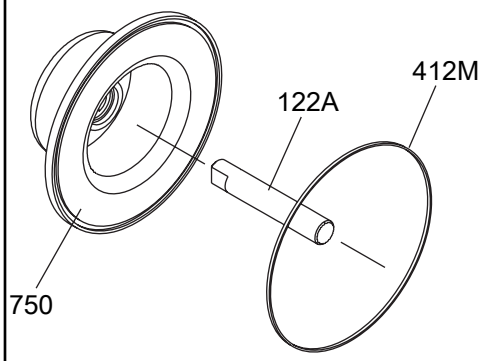


Figure 44: XS group

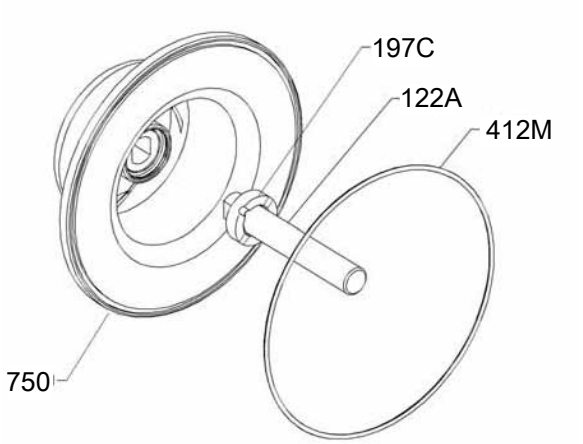


Figure 45: 3298, SP3298, and V3298 S, M, and L groups

10. For the SP3298, complete these steps:
    a) Place the backplate (444) face down on the work surface.
    b) Place the containment shell with the reverse thrust bearing in the backplate.
    c) Place a clamp ring (141C) over the containment shell and secure with clamp ring bolts (356A).
    d) Coat the O-ring (412V) with an O-ring lubricant. Insert the O-ring in the backplate.
    The lubricant helps the O-ring remain in place.

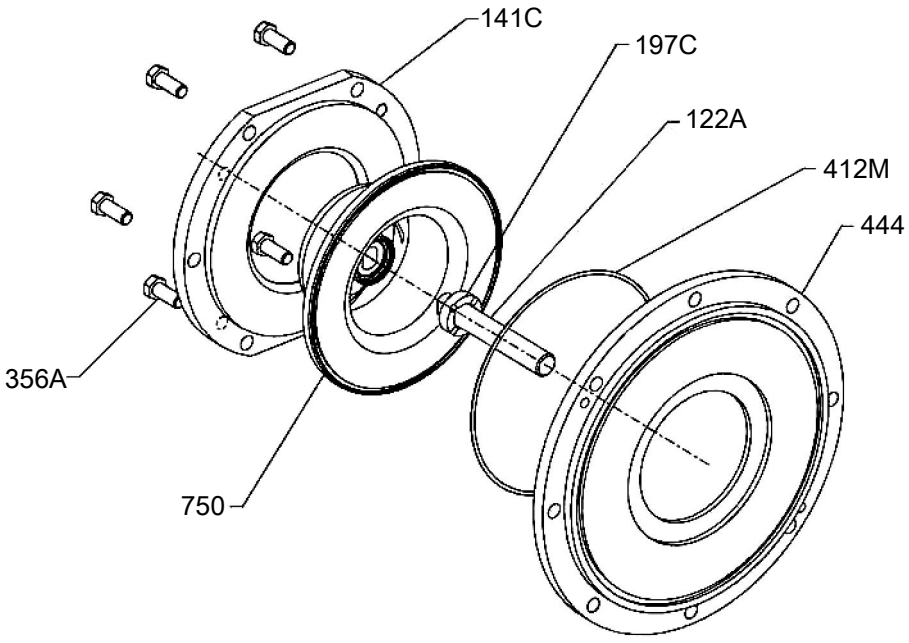


Figure 46: SP3298

11. Slide the impeller assembly (101) onto the shaft.

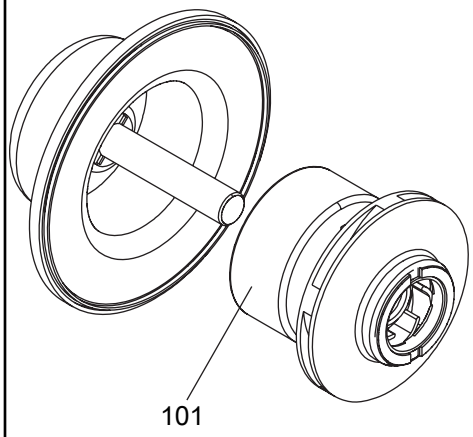


Figure 47: 3298 XS, S, M, and L groups, and V3298

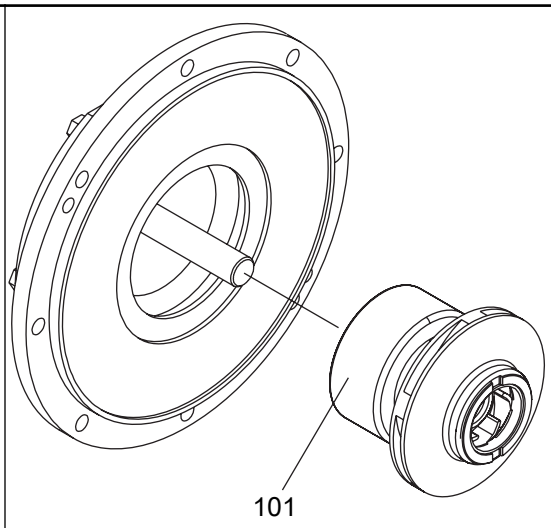


Figure 48: SP group

12. Press the spider (101A) into the volute insert (100U) with the spider tool. Then press the volute insert with the spider into the casing (100).

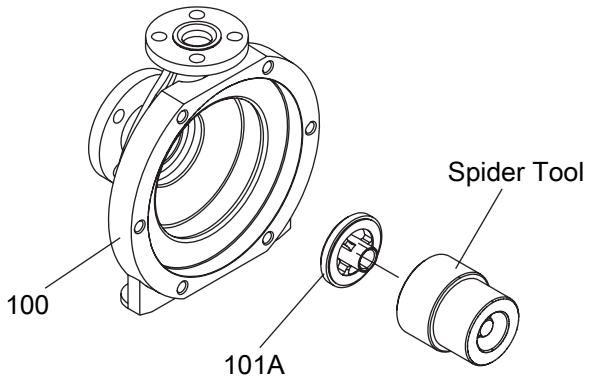


Figure 49: 3298

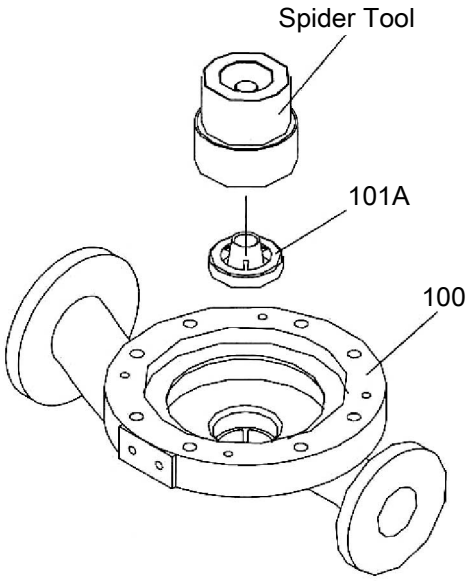


Figure 50: V3298

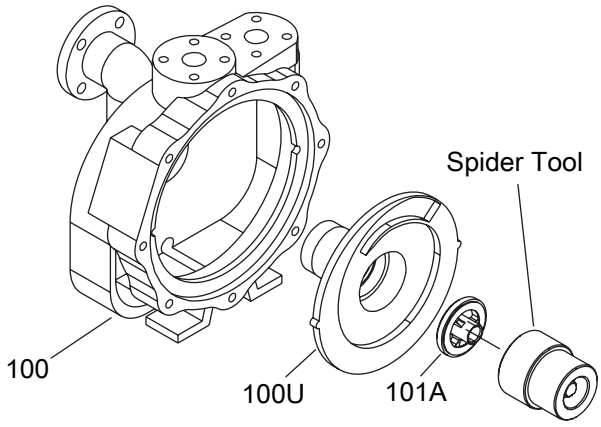


Figure 51: SP3298

13. Check the total travel of the rotary assembly:

Pump group	Travel between A and B in inches (millimeters)
3298 XS	0.026 - 0.083 in. (0.66 - 2.11 mm)
3298 S, V3298 S, and SP3298	0.013 - 0.100 in. (0.33 - 2.5 mm)
3298 M and L, and V3298 M	0.020 - 0.105 in. (0.51 - 2.67 mm

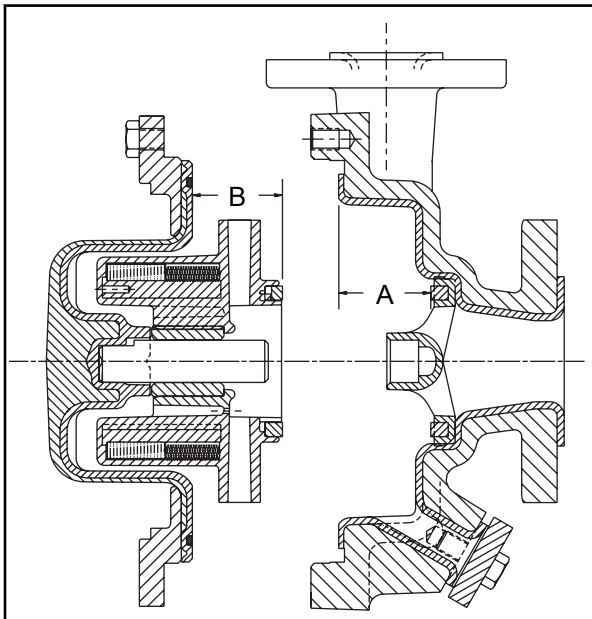


Figure 52: 3298 XS group

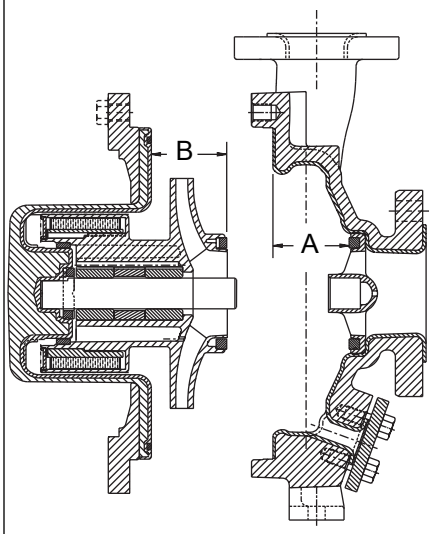


Figure 53: 3298 S, M, and L groups

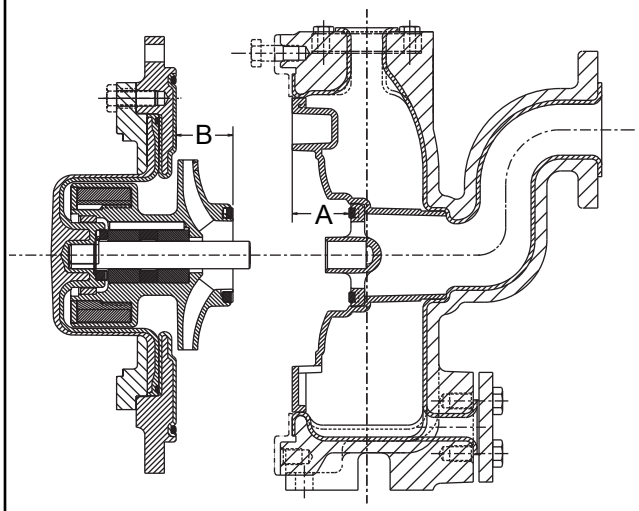


Figure 54: SP3298

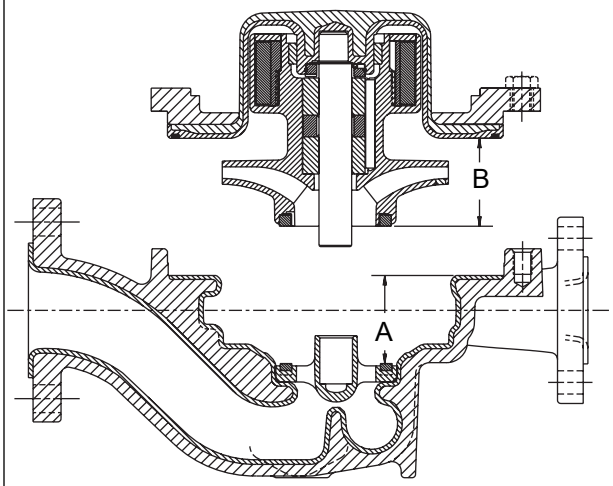


Figure 55: V3298

14. For the 3298 and V3298, install these items into the casing:
    a) Install the containment shell and impeller assembly into the casing (100). Use care that the O-ring (412M) remains in place.
    b) Install the clamp ring (141C) into the casing (100) with the hex capscrews (356A).

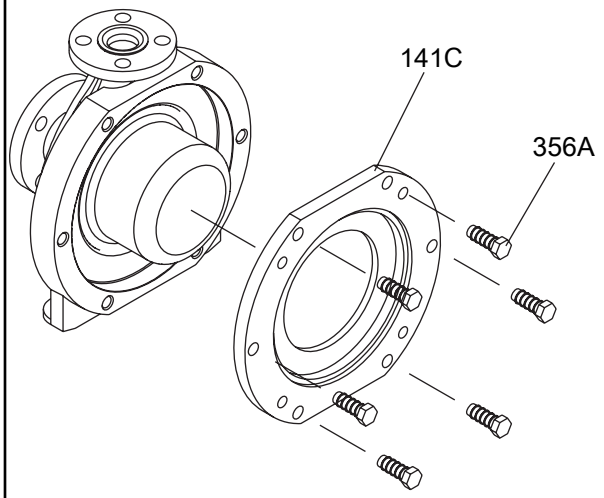


Figure 56: 3298 XS, S, M, and L groups

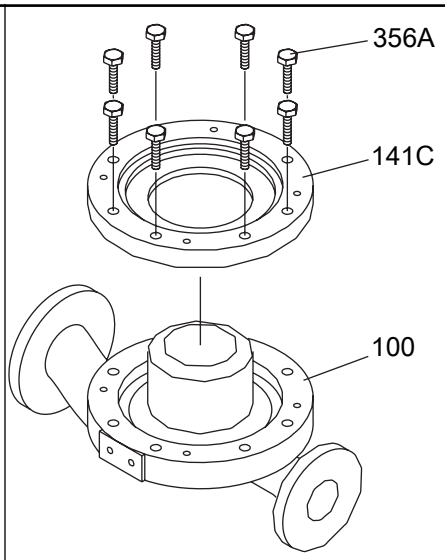


Figure 57: V3298

15. Install the impeller assembly and backplate/clamp ring/containment shell assembly into the casing (100) using casing bolts (372V). Make sure that the O-ring remains in place.

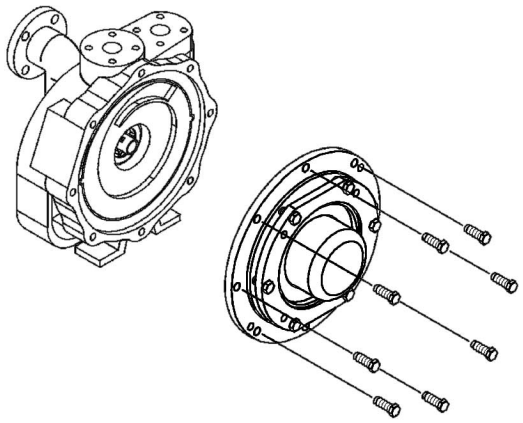


Figure 58: SP3298

16. Set the partially-built assembly aside and away from any attracting metals.

Continue the assembly with the close coupled or frame mounted version of assembly as described in this chapter.

Reassemble the close-coupled pump

1. Install four expansion plugs (408Z) into the C-face motor support (228) by tapping on the plug with a 5/8 in. rod.

   Expansion plugs are not used for the 182TC - 256TC and 324TSC motor frames.

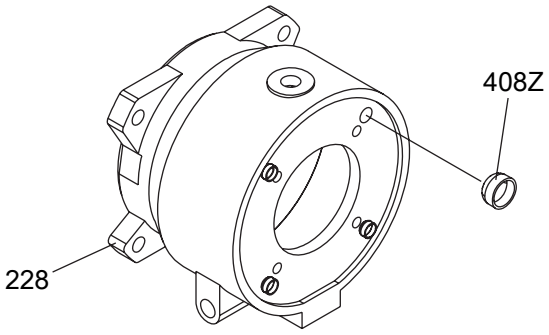


Figure 59: Close coupled frame

2. Set the C-face motor support (228) on the motor and install four screws (371).
3. Slide the key (178Y) into the motor shaft keyway.
4. Install two setscrews (222L) into the magnet assembly (740B).

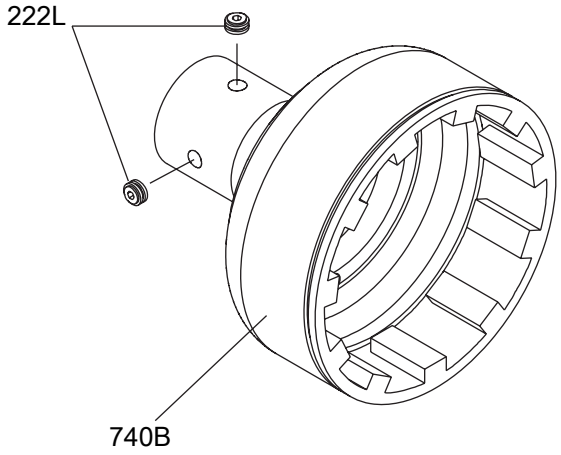


Figure 60: Drive magnet

5. Slowly drop in the magnet assembly until the shim rests on the face of the C-face motor support.

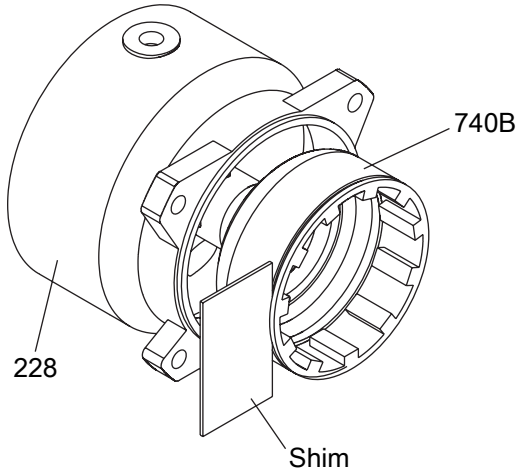


Figure 61: Drive magnet assembly

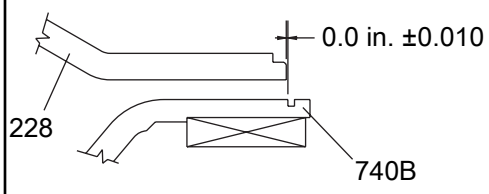


Figure 62: XS and S group installation dimensions

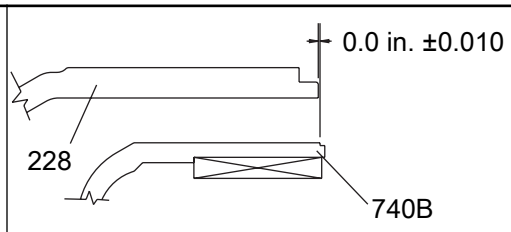


Figure 63: M and L group installation dimensions

6. Rotate the magnet assembly (740B) to line up the key (178Y) with the access hole on the C-face motor support (228).
7. Tighten the first setscrew (222L) through the access hole.
8. Remove the shim and rotate the magnet assembly 90° in order to access the other setscrew.
9. Tighten the setscrew.

Reassemble the frame-mounted pump

1. Install the ball bearings (112) on the shaft (122B) at both ends.
2. Install the lipseal (333D) in the bearing frame (228).

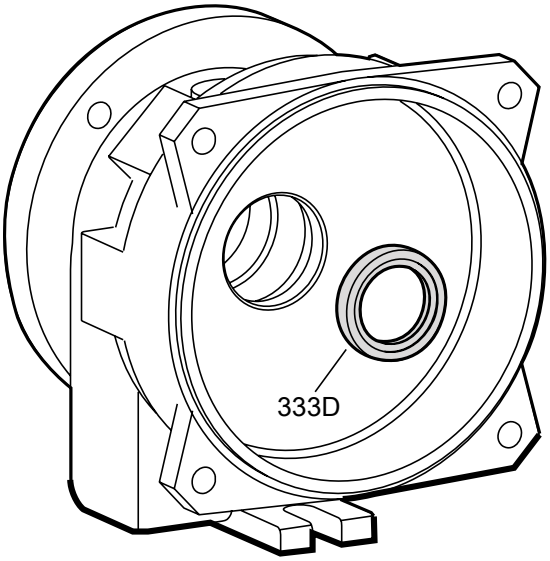


Figure 64: Bearing frame

3. Bolt or clamp the bearing frame (228) to the work bench.

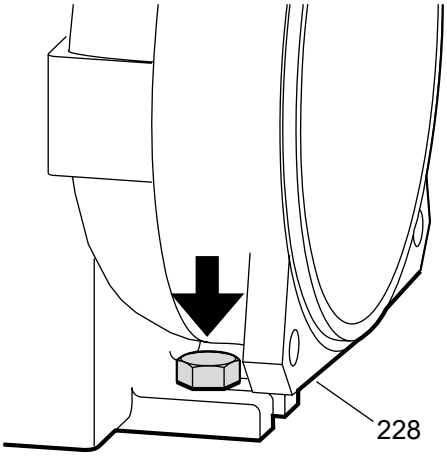


Figure 65: Bearing frame secured to bench

4. Install the shaft (122B) with ball bearings (112) into the bearing frame (228). Point the threaded end of the shaft towards the magnets.

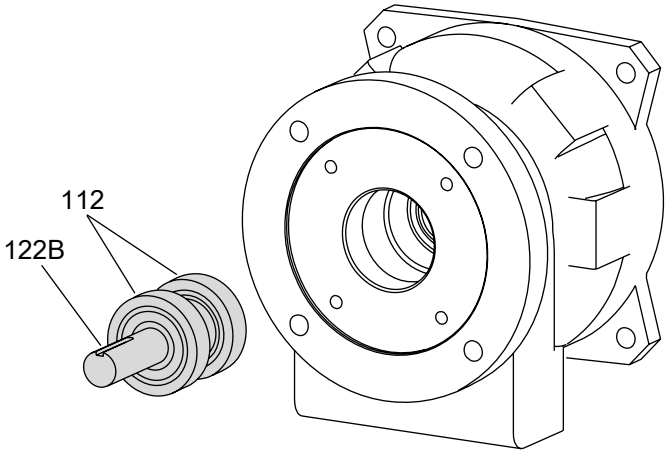


Figure 66: S group bearing installation

5. For the M and L group, install the wave washer.

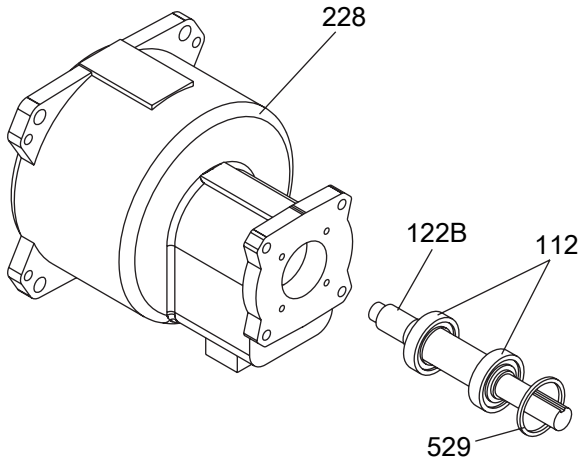


Figure 67: M and L group bearing installation

6. Install the bearing-end cover gasket (360A) and bearing end cover (109A) with hex capscrews (370C).

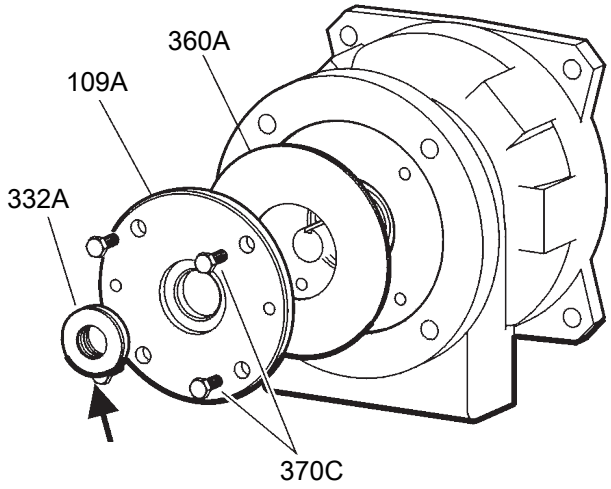


Figure 68: Bearing frame assembly

7. Press the labyrinth seal (332A) into the end cover (109A):
   a) Make sure that the O-rings are in grooves of labyrinth seal.
   b) Orient the expulsion ports to the 6 o'clock position and press the seal into the bearing end cover (109A) until it is shouldered against the end cover.

      No adjustment is necessary.
8. Install the key (178Y) on the shaft (122B).

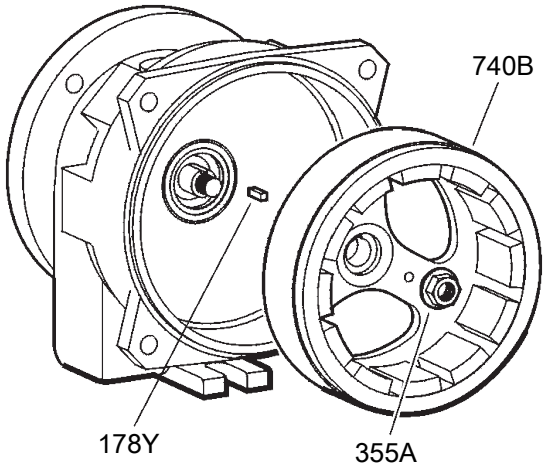


Figure 69: Drive magnet assembly

9. Install the magnet assembly (740B) onto the shaft (122B).
10. Place a shaft wrench on the drive shaft (122B). Install a hex nut (355A) and tighten the nut per the Bolt torque values table in the Reassembly section of the Maintenance chapter.
11. For the M and L groups, complete these steps:
    a) Install the rub ring (144A) into the bearing frame (228).
    b) Line up the hole in the rub ring with the tapped hole in the frame (228) by using the scribed mark on the rub ring to reference the tapped hole in the frame.
    c) Lightly tap the rub ring (144A) with a rubber mallet until it shoulders into the bearing frame (228).
    d) For the M and L groups, install a 5 /16 in. hex capscrew (372Y) into the bottom of the frame (228).

    This capscrew prevents the rub ring (144A) from rotating during pump operation.

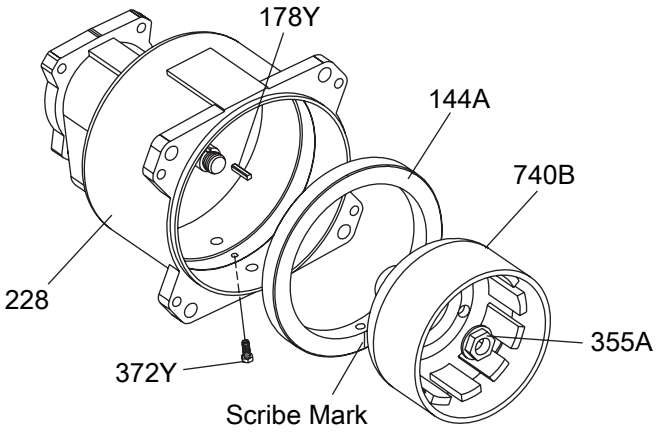


Figure 70: M and L group drive magnet assembly

Complete the reassembly (close-coupled and frame-mounted pumps)

1. For all groups except XS, install the gasket (360W) into the clamp ring (141C).
2. Bolt the C-face support and frame (228) to the work bench.
3. For the M and L groups, install guide rods:
    a) Tighten the jacking screws (418) until they are fully extended through the C-face support and frame flange (228).

    Check that extension from the frame is approximately 3.50 in. (8.89 cm).

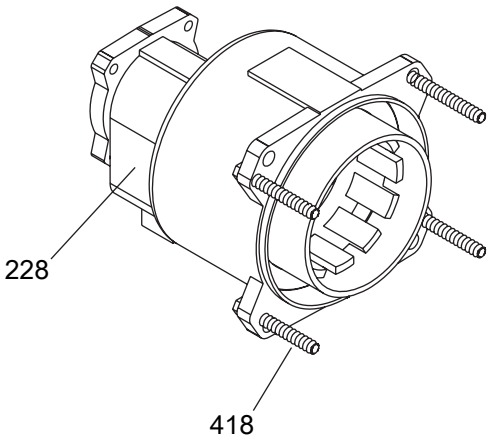
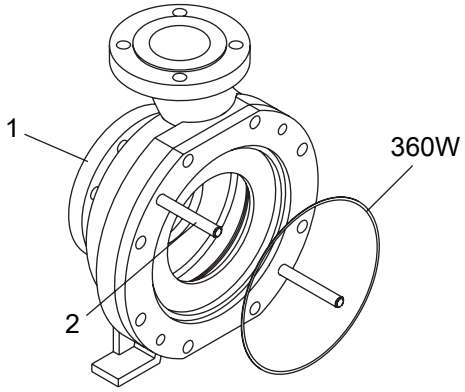


Figure 71: Bearing frame with guide rods

b) Install the two guide rods (B03189A) into the clamp ring (141C).

These rods help you guide the casing assembly into the C-face support and frame (228), which contains the drive magnets (740B).

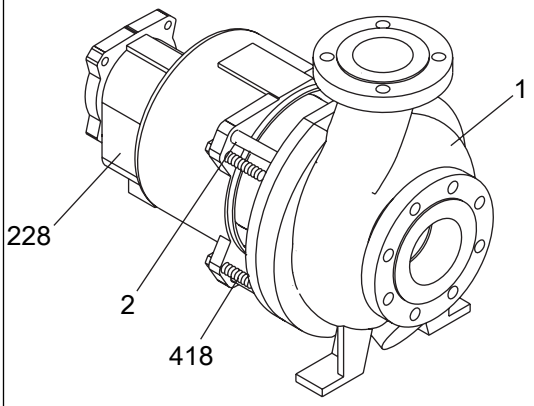


1. Casing assembly
2. Guide rods

Figure 72: Casing assembly with guide rods

4. Slide the casing assembly into the C-face support and bearing frame assembly:

If your pump group is...	Then...
XS or S	1. Hold the casing firmly by the suction flange and suction side of the discharge flange. Keep hands away from the clamp ring in order to avoid pinched fingers. 2. Slowly insert the casing in order to avoid damage.
M or L	1. Position the casing assembly so that the two guide rods are engaged into two of the C-face support and frame capscrew holes and the jacking screws (418) contact the casing assembly clamp ring (141C). 2. Loosen the jacking screws (418) and slowly draw the casing assembly into the C-face support and bearing frame assembly. Keep hands away from clamp ring to avoid pinched fingers.

If your pump group is...	Then...
	 1. Casing assembly 2. Guide rods

5. Secure with four hex capscrews (370B) and tighten.

Assembly references

Bolt torque values

Location	Dry threads torque in ft-lbs (Nm)
Hex nut – 355A	30 (40)
Clamp ring screws – 356A	30 (40)
Support / frame screws – 370B	30 (40)
Cover-to-frame – 370C	30 (40)
Drain screws – 426A XS and S	14 (19)
Drain screws – 426A M and L	18 (25)

Impeller trimming guidelines

Precautions

- Do not chuck the impeller assembly.
- Do not make cuts that are larger than 0.050 in. (0.127 cm)
- Do not over-tighten the arbor screw because this can crack the carbon bearings.

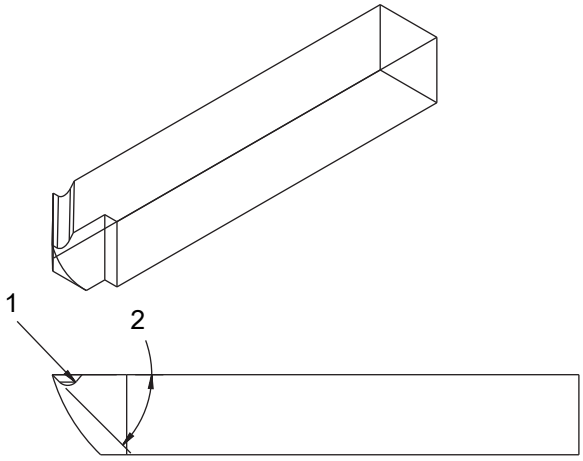
Required tools

Group	Sizes	Arbor tool
XS	1 x $1^1/_2$-5	A06785A01
S	1 x $1^1/_2$-6 1 x $1^1/_2$-8 2 x 3-6	A06785A02
M and L	2 x 3-8 3 x 4-7 1 x 2-10 3 x 4-10 4 x 6-10	A06785A03

You can use nylon impeller arbor sleeves in place of bearings:

- XS group–B04674A01
- S group–B04676A02

- M group–B04676A03
- L group–B04676A04



1. Small radius 0.005 to 0.002
2. 45° rake angle

Figure 73: Recommended cutting tool

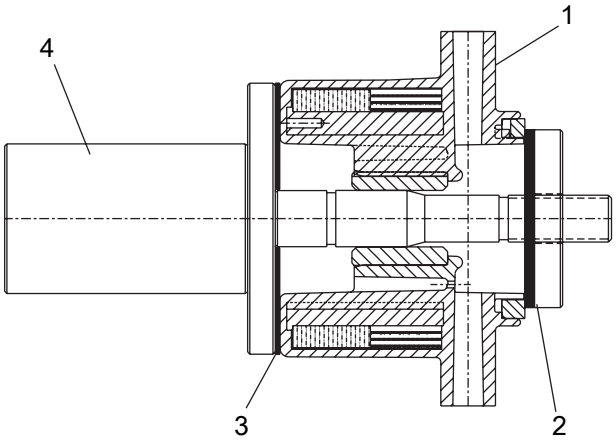
Tool features:

- 200 to 300 RPM
- 300 to 500 ft./min
- High-speed steel tool
- Light hand feed

Trimming guidelines

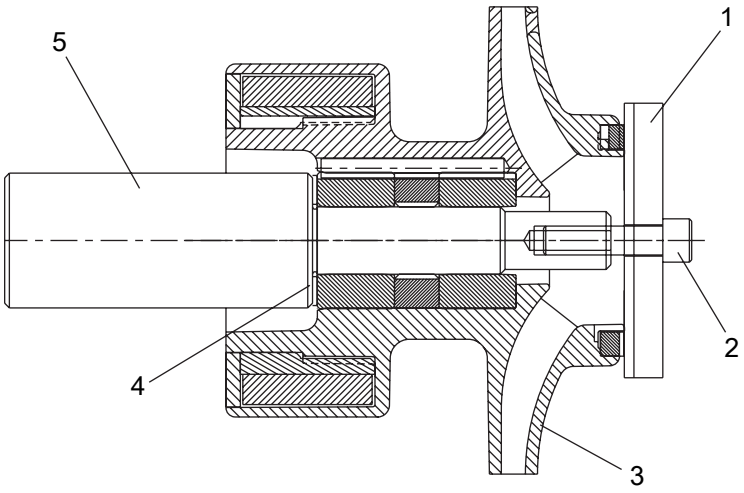
- Make sure that the arbor runs within 0.002 TIR.
- Tighten the screw only enough to turn the impeller without it slipping.
- The allowed front shroud TIR is 0.060 in. (0.152 cm)
- For the XS impeller, trim both the front and back shrouds and the vanes to a minimum diameter of 3.75 in. (9.53 cm).
- When you trim between 3.00 in. (7.62 cm) and 3.75 in. (9.53 cm), trim only the front shroud and the vanes.

Trimming examples



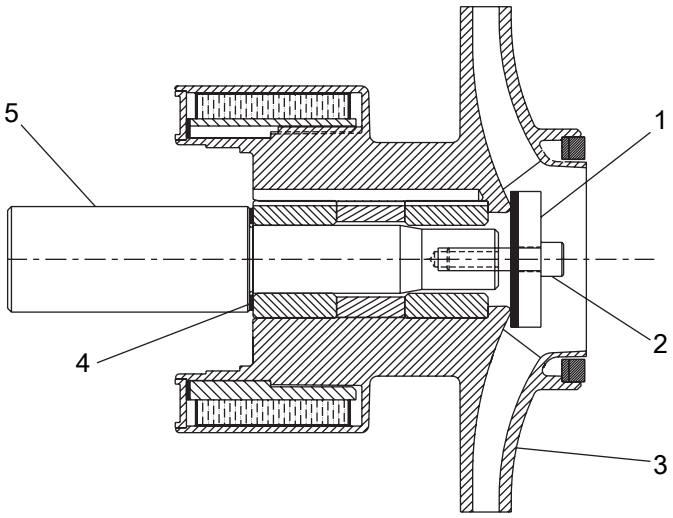
1. Impeller
2. Steel washer with rubber bond
3. Paper gasket
4. Arbor

Figure 74: XS group



1. Steel washer with rubber bond
2. Socket head capscrew
3. Impeller
4. Paper gasket
5. Arbor

Figure 75: S and M groups



1. Steel washer with rubber bond
2. Socket head capscrew
3. Impeller
4. Paper gasket
5. Arbor

Figure 76: L group

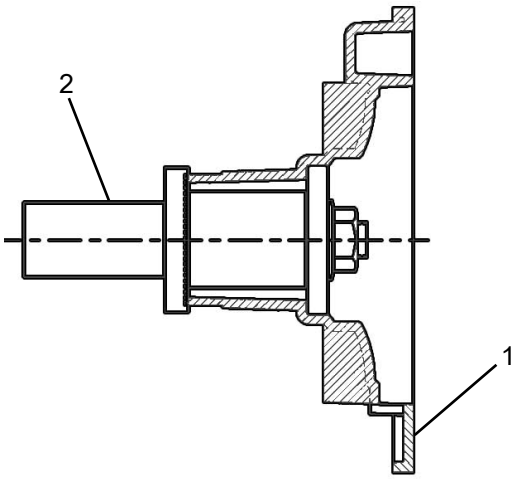
SP3298 volute insert trimming guidelines

Trimming guidelines

Do not make cuts larger than 0.050 in (0.127 cm)

Use arbor tool C06820A for SP3298 size 1x1.5-6 and C06821A for SP3298 size 2x3-6.

Make sure that the arbor runs within 0.002 in. (0.005 cm) TIR.



1. Volute insert
2. Arbor

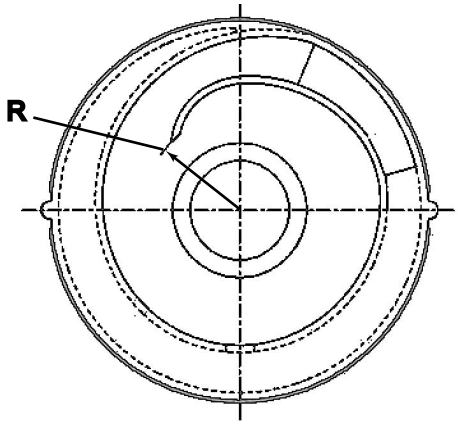
Cutwater trimming guidelines

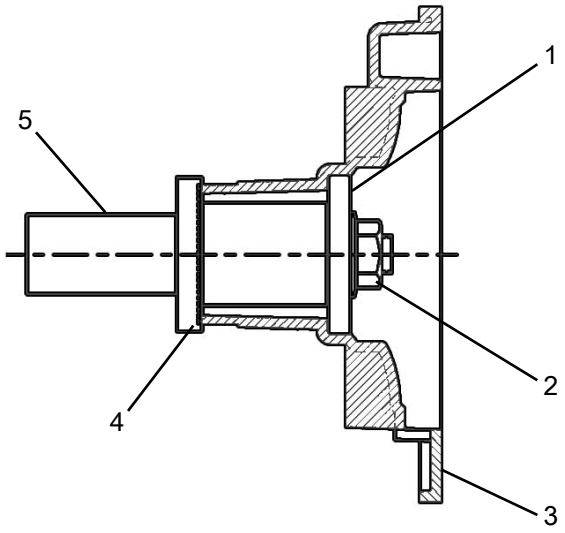
Machine the cutwater to full depth using radius dimension "R" as shown in the Cutwater radius table.

Use arbor tool C06820A for SP3298 size 1x1.5-6 and tool C06821A for SP3298 size 2x3-6.

Table 8: Cutwater radius

Impeller diameter in inches (centimeters)	"R" +/- 0.010 inches (0.25 mm)
5.00 (12.70)	2.563 (6.510)
5.12 (13.00)	2.625 (6.668)
5.25 (13.34)	2.688 (6.827)
5.38 (13.67)	2.750 (6.985)
5.50 (13.97)	2.813 (7.145)
5.62 (14.27)	2.875 (7.303)
5.75 (14.61)	2.938 (7.463)
5.88 (14.94)	3.000 (7.620)
6.00 (15.24)	3.063 (7.780)
6.06 (15.39)	3.094 (7.859)





1. Steel washer with rubber bond
2. Hex flange nut
3. Volute insert
4. Paper gasket
5. Arbor

Spare parts

Liquid end

Part	Part number	Material	Quantity
Containment shell O-ring	412M	Standard – viton Optional – EDPM Optional – Teflon-encapsulated viton	1
Gasket – clamp ring	360W	Aramid fiber / EDPM binder	1
Bearing spider	101A	Tefzel / silicon carbide	1
Impeller bearing	178S	Tefzel	1
Radial bearing	197B	Standard – carbon Optional – silicon carbide Optional – DryGuard silicon carbide	2
Reverse thrust bearing	197C	Carbon-filled Teflon	1
Impeller thrust bearing	197D	Standard – carbon filled Teflon Optional – silicon carbide Optional – DryGuard silicon carbide	1
Rear impeller wear ring (M and L groups)	203	Standard – carbon filled Teflon	1

Power end – frame-mounted

Part	Part number	Material	Quantity
End cover gasket	360A	Varnished Kraft	1
Labyrinth seal	332A	Carbon filled Teflon	1
Ball bearing	112	Steel	2
Lip seal	333D	Buna rubber	1

Part	Part number	Material	Quantity
Hex flange nut	355A	Steel	1
L group impeller O-ring	496G	Standard – viton Optional – EDPM Optional – Teflon encapsulated viton	1

Repair kits

Size	Repair cartridge[1]			Power end kit[2]
	Carbon	Silicon carbide	Dry-guard™	
XS				
1 x 1.5-5	C298X1500CV000	C298X1500SV000	C298X1500FV000	N/A
1.5 x 2-6	C298X1560CV000	C298X1560SV000	C298X1560FV000	N/A
S				
1 x 1.5-6	C298S1600CV000	C298S1600SV000	C298S1600FV000	R298PKS
1 x 1.5-8	C298S1800CV000	C298S1800SV000	C298S1800FV000	R298PKS
1.5 x 3-7	C298S1570CV000	C298S1570SV000	C298S1570FV000	R298PKS
2 x 3-6	C298M2800CV000	C298M2800SV000	C298M2800FV000	R298PKS
M				
1.5 x 3-8	C298M1580CV000	C298M1580SV000	C298M1580FV000	R298PKML
1 x 2-10	C298M1100CV000	C298M1100SV000	C298M1100FV000	R298PKML
2 x 3-8	C298M2800CV000	C298M2800SV000	C298M2800FV000	R298PKML
3 x 4-7	C298M3700CV000	C298M3700SV000	C298M3700FV000	R298PKML
L				
1.5 x 3-10	C298L1510CV000	C298L1510SV000	C298L1510FV000	R298PKML
2 x 3-10	C298L2100CV000	C298L2100SV000	C298L2100FV000	R298PKML
3 x 4-10H	C298L3100CV000	C298L3100SV000	C298L3100FV000	R298PKML
3 x 4-10G	C298L310GCV000	C298L310GSV000	C298L310GFV000	R298PKML
4 x 6-10	C298L4100CV000	C298L4100SV000	C298L4100FV000	R298PKML

[1]The repair cartridge is a fully-assembled kit with a trimmed impeller and includes the spider, thrust bearing, bearing spacer, bearing key, radial bearings, rear impeller wear ring (if required), shaft, reverse thrust bearing, and the containment shell. L groups also include a magnet retaining ring and a support o-ring.

[2]The power-end repair kits include the ball bearings, drive carrier key, lip seal, hex flange nut, bearing-end cover gasket, frame gasket, and the labyrinth O-rings.

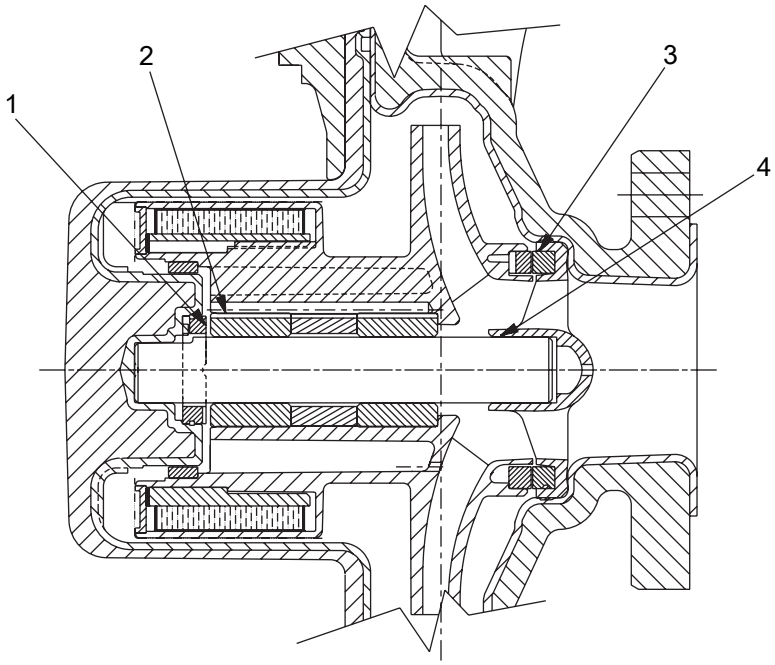
Troubleshooting

Operation troubleshooting

Symptom	Cause	Remedy
The pump is not delivering liquid.	The pump is not primed.	For the 3298 and V3298, reprime the pump and check that the pump and suction line are full of liquid.
		For the SP3298: • Add an initial charge to the casing. • Since the suction lift is greater than the maximum allowed, raise the sump level.
	The suction line is clogged.	Check the suction line pressure. If it is low, locate and remove any obstructions.
	The impeller is clogged.	Disassemble the impeller and remove the blockage.
	The magnet is de-coupling.	Shut down the pump and check the temperature and viscosity of the pumped fluid.
The suction line is clogged.	Check the suction line pressure. If it is low, locate and remove any obstructions.	
The impeller is clogged.	Disassemble the impeller and remove the blockage.	
The magnet is de-coupling.	Shut down the pump and check the temperature and viscosity of the pumped fluid. Check the magnets with a breakaway torque test.	
The pump is not producing rated flow or head.	There is an air leak in the suction line.	Check for leaks and repair the lines.
	The impeller is partly clogged.	Back flush the pump to clean the impeller.
	The impeller rings are worn.	Replace the defective ring as required.
	There is insufficient suction head.	Make sure that the suction line shutoff valve is fully open and the line is unobstructed. Check the suction pressure.
	The impeller is either worn or broken.	Inspect and replace the impeller if necessary.
	The rotation is wrong.	Correct the wiring.
Pump starts and then stops pumping.	The pump is not primed correctly.	Reprime the pump.
	There is an air leak in the suction line.	Check for leaks and correct.
	The magnet is de-coupling.	Shut down the pump. Check the temperature and viscosity of the pumped fluid.
	There are either air or vapor pockets in the suction line.	Rearrange the piping to eliminate air pockets.
The bearings run hot.	The bearings are not lubricated properly.	Check the suitability and level of the lubricant.
	The lubricant is cooling.	Check the cooling system.
	The pump is not aligned properly.	Check the pump alignment.

Symptom	Cause	Remedy
Pump is noisy or vibrates.	The pump or driver is not aligned properly.	Align the shafts.
	There is a partially-clogged impeller causing the imbalance.	Disassemble the impeller and remove the blockage.
	There is a broken or bent impeller or shaft.	Replace as required.
	The base is not rigid enough.	Tighten the pump and motor hold-down bolts or adjust the stilts. Then check the grout.
	The suction or discharge piping is not anchored or properly supported.	Anchor the piping per the Hydraulic Institute Standards recommendations (Edition 14, centrifugal pump section).
	The pump is cavitating.	Increase the NPSH available.
The motor requires excessive power.	The head is lower than the rating and the pump has too much liquid.	Install a throttle valve.
	The liquid is heavier than expected.	Check the specific gravity and viscosity.
	The head is higher than the rating, which is at capacity.	Check the impeller diameter.
	The rotating parts are binding or are severely worn.	Check the internal wearing parts for proper clearances.
	The motor rotation is incorrect.	Correct the wiring.
The condition monitoring device shuts down the pump.	The sleeve and thrust bearings are damaged.	Replace as required.
	There is a plugged recirculation circuit.	Disassemble and remove the blockage. Then determine and correct the cause of the blockage.
	There is recirculation liquid vaporization.	Correct all of these as necessary: • Check the actual liquid temperature versus the design temperature. • Check the actual NPSH available versus the design. • Check the minimum flow requirement for the pump size.
	The containment shell is damaged.	Replace as required.
	The magnets are de-coupling.	Check the temperature and viscosity of the pumped fluid.
	The pump is running dry.	• Check the control device for proper operation. • Check the suction line for blockage. • Reprime the pump.
	There is excessive motor power.	The system head is lower than the rating and pumps too much liquid. Check the rotating parts for binding and wear. The liquid is heavier than expected.

Symptom	Cause	Remedy
There is a significant increase in heat generation.	There is either insufficient lubrication or you ran the liquid lubricated bearing surfaces dry. The lack of cooling flow through the pump also causes significant increases in bearing temperature. This temperature increase causes damage to the surrounding parts. See the Increase in heat generation figure for details.	• Install a dry run protection device like a power monitor. • Modify the process system or controls in order to eliminate the dry run operation. • Change the bearing material to DryGuard™ coated silicon carbide if silicon carbide bearings were initially installed in the pump.



1. Check to see if the plastic that surrounds the outboard thrust bearing is melted.
2. Check to see if the plastic that surrounds the carbon or silicon carbide impeller radial bearings is melted.
3. Check to see if the plastic that surrounds the inboard thrust bearings is melted.
4. If the impeller seizes on the shaft due to excessive heat, the shaft can spin in the shaft spider, which wears the inside diameter of the shaft spider.

Figure 77: Increase in heat generation

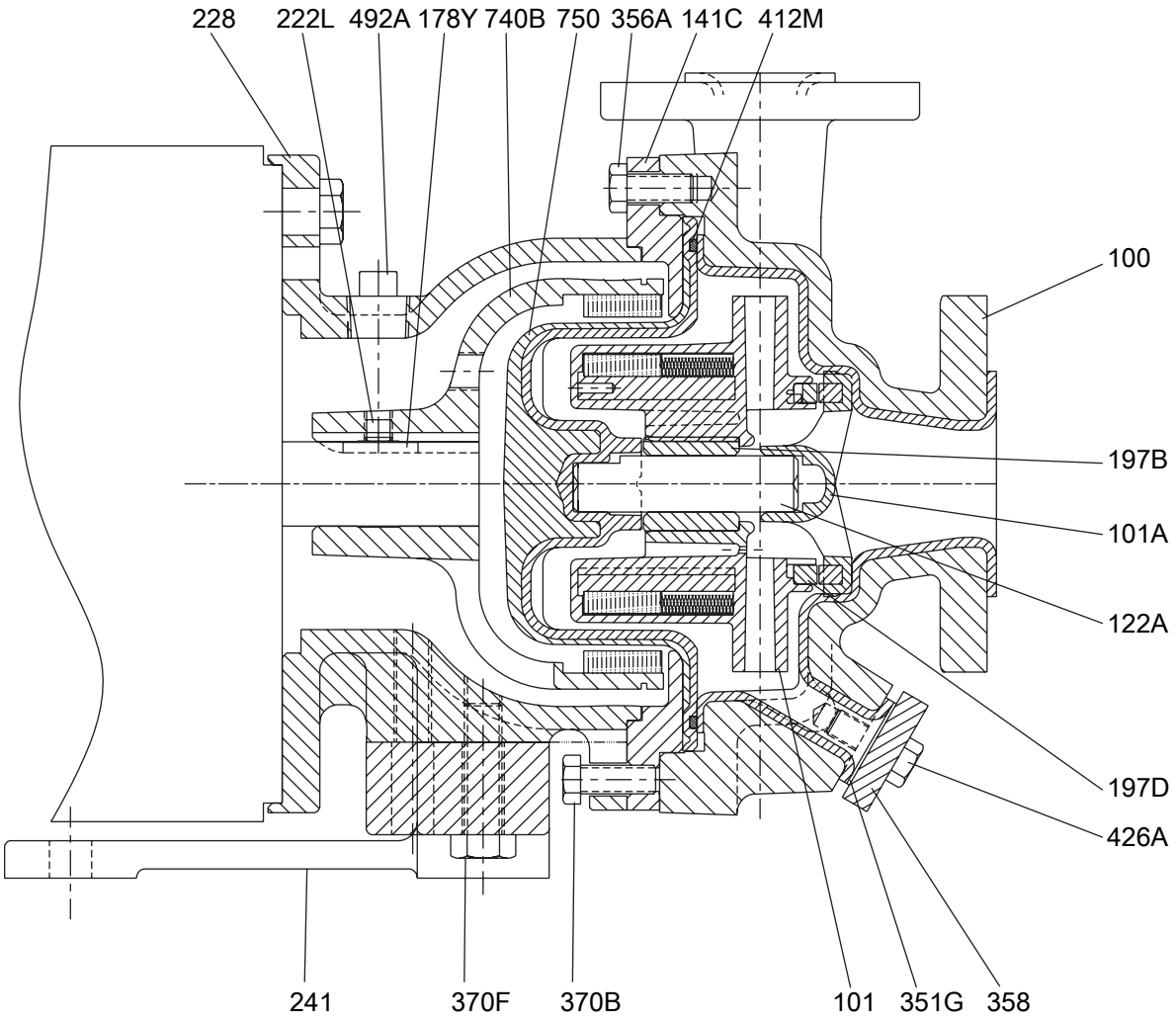
Alignment troubleshooting

Symptom	Cause	Remedy
Horizontal (side-to-side) alignment cannot be obtained (angular or parallel).	The driver feet are bolt-bound.	Loosen the pump's hold-down bolts, and slide the pump and driver until you achieve horizontal alignment.
	The baseplate is not leveled properly and is probably twisted.	1. Determine which corners of the baseplate are high or low. 2. Remove or add shims at the appropriate corners. 3. Realign the pump and driver.
Vertical (top-to-bottom) alignment cannot be obtained (angular or parallel).	The baseplate is not leveled properly and is probably bowed.	1. Determine if the center of the baseplate should be raised or lowered. 2. Level screws equally at the center of the baseplate. 3. Realign the pump and driver.

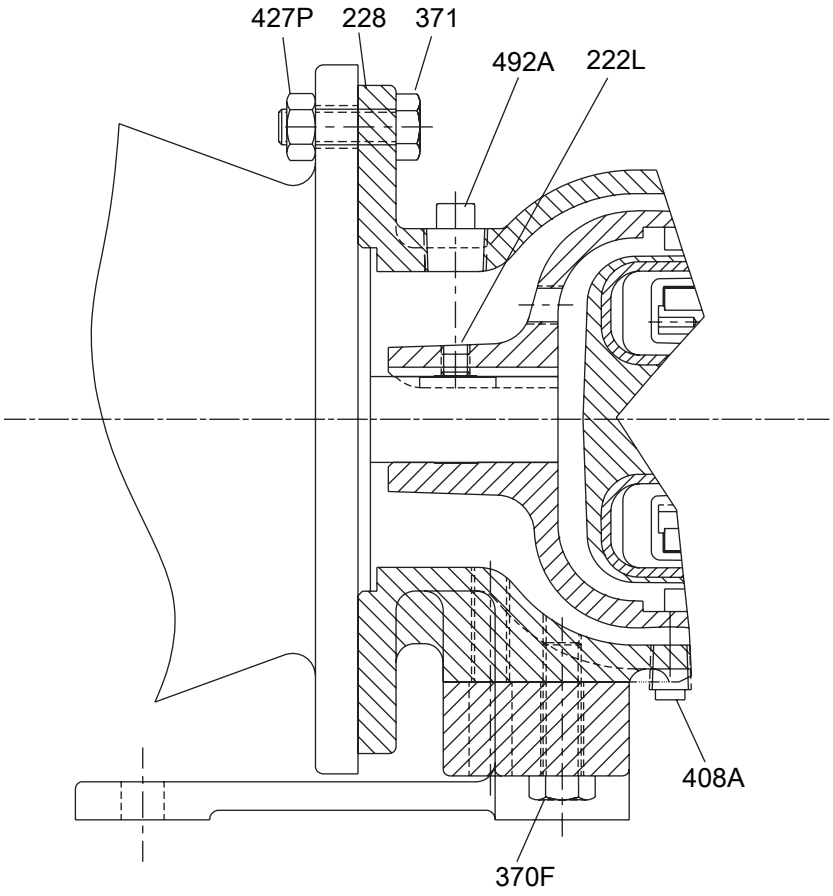
Parts Listings and Cross-Sectional Drawings

3298 XS group close-coupled pump in sizes 1 x 1-1/2 - 5 and 1-1/2 x 2-6

With NEMA motor



With IEC motor



Parts list

Item	Part name	Material
100	Casing	Ductile iron / Tefzel
101	Impeller assembly	Carbon-filled Tefzel
101A[1]	Bearing spider	Standard: carbon-filled Tefzel / silicon carbide Optional: Dry-guard silicon carbide
122A	Stationary shaft	Standard: silicon carbide Optional: Dry-guard silicon carbide
141C	Clamp ring	Ductile iron
178Y	Key – motor to magnet assembly	Steel
197B[1]	Bearing – radial	Standard: carbon graphite Optional: silicon carbide Optional: Dry-guard silicon carbide
197D[1]	Bearing – impeller thrust	Standard: carbon/glass-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
222L	Setscrew	Steel
228	C-face motor support	Cast iron
241[2]	Frame foot	Ductile iron
351G	Gasket – casing drain	Gylon

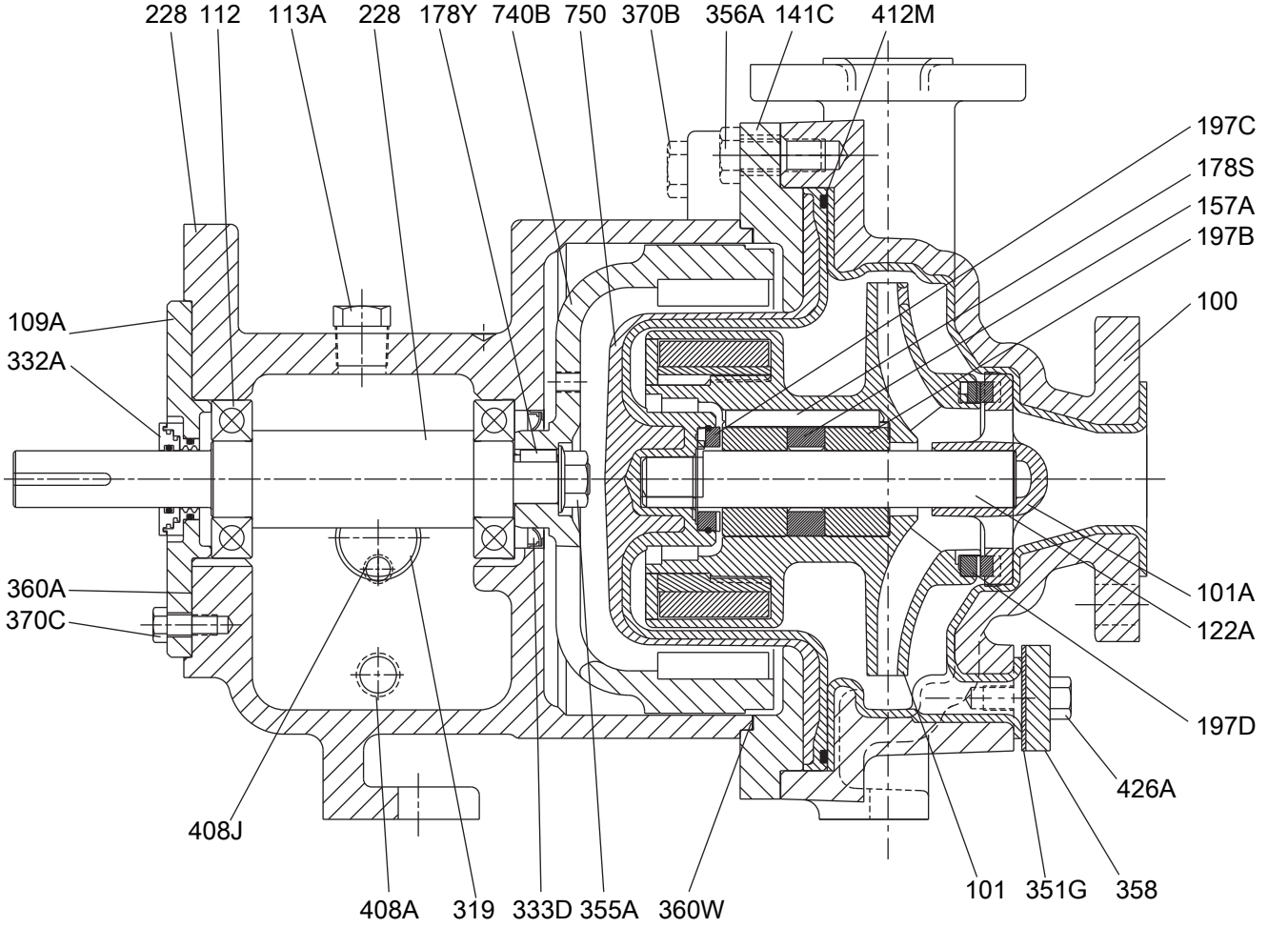
Item	Part name	Material
356A	Hex capscrew – clamp ring to casing	304 SS
358	Cover – drain	Steel
370B	Hex capscrew – support to clamp ring	304 SS
412M[1]	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon – encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
426A	Hex capscrew – drain cover	304 SS
492A	Plug – access hole	Steel
740B	Drive carrier	Carbon-filled Tefzel / fiber-reinforced vinylester
750	Containment shell	Carbon-filled Tefzel / Fiber-reinforced Vinylester

[1]Recommended spare parts

[2]Not supplied on size 1.5 x 2-6 with the 213/215TC motor frame.

3298 S group frame-mounted pump in sizes 1 x 1-1/2 - 6, 1 x 1-1/2 - 8, 1-1/2 x 3-7, and 2 x 3-6

S group frame-mounted drawing



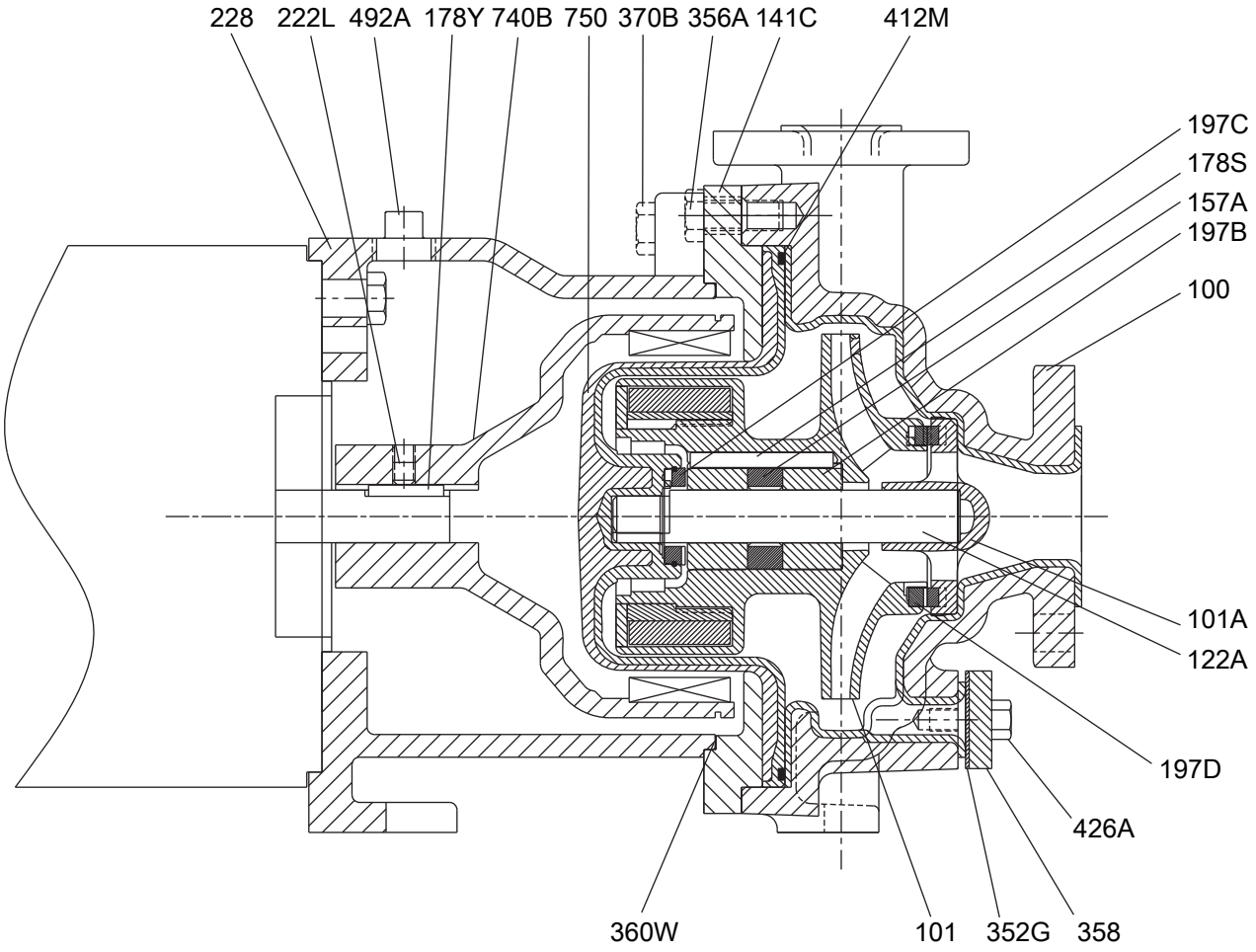
S group frame-mounted parts list

Item	Part name	Material
100	Casing	Ductile iron / Tefzel
101	Impeller assembly	Carbon-filled Tefzel
101A[1]	Bearing spider	Standard: carbon-filled Tefzel / silicon carbide Optional: carbon-filled Tefzel / Dry-guard silicon carbide
109A	End cover	Ductile iron
112[1]	Ball bearings	Steel
122A	Stationary shaft	Standard: silicon carbide Optional: Dry-guard silicon carbide
122B	Drive shaft	Steel
141C	Clamp ring	Ductile iron
157A	Bearing spacer – radial bearings	Teflon

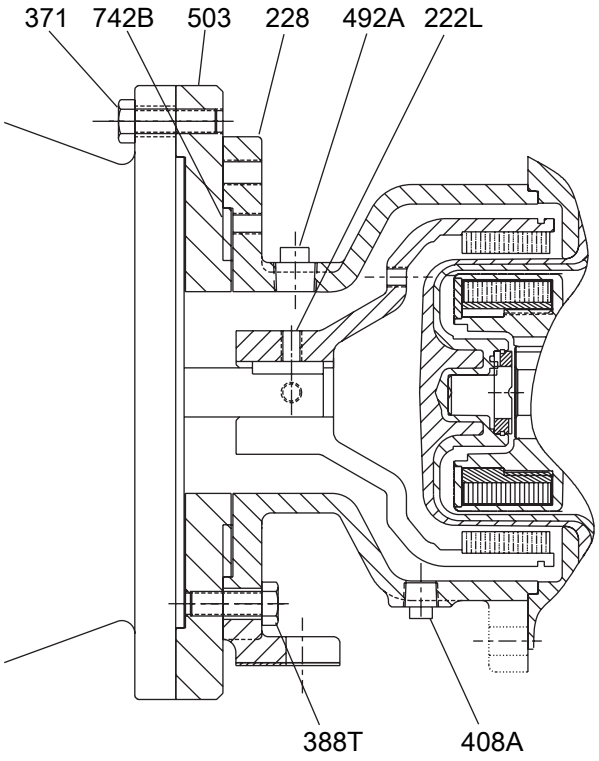
Item	Part name	Material
178S[1]	Key – impeller to radial bearings	Teflon
178Y	Key – drive carrier	Steel
197B[1]	Bearing – radial	Standard: silicon carbide Optional: Dry-guard silicon carbide
197C[1]	Bearing – reverse thrust	Carbon-filled Teflon
197D[1]	Bearing – impeller thrust	Standard: carbon-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
228	Frame – bearing	Cast iron
332A[1]	Labyrinth seal – outboard	Brass
333D[1]	Oil lip seal – inboard	Buna rubber
351G[1]	Gasket – casing drain	Gylon
355A[1]	Hex nut	Steel
356A	Hex capscrew – clamp ring to casing	304 SS
358	Flange – casing drain	Steel
360A[1]	Gasket – end cover to frame	Varnished Kraft
360W	Gasket – frame to clamp ring	Aramid fibers with EPDM
370B	Hex capscrew – frame to clamp ring	304 SS
370C	Hex capscrew – end cover	304 SS
412M[1]	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon-encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
426A	Hex capscrew – casing drain	304 SS
740B	Drive magnet assembly	Cast iron / neodymium iron
750	Containment shell	Tefzel / fiber-reinforced vinylester
[1] Recommended spare parts		

3298 S group close-coupled pump in sizes 1 x 1-1/2 - 6, 1 x 1-1/2 - 8, 1-1/2 x 3-7, and 2 x 3-6

With NEMA motor



With IEC motor



S group close-coupled parts list

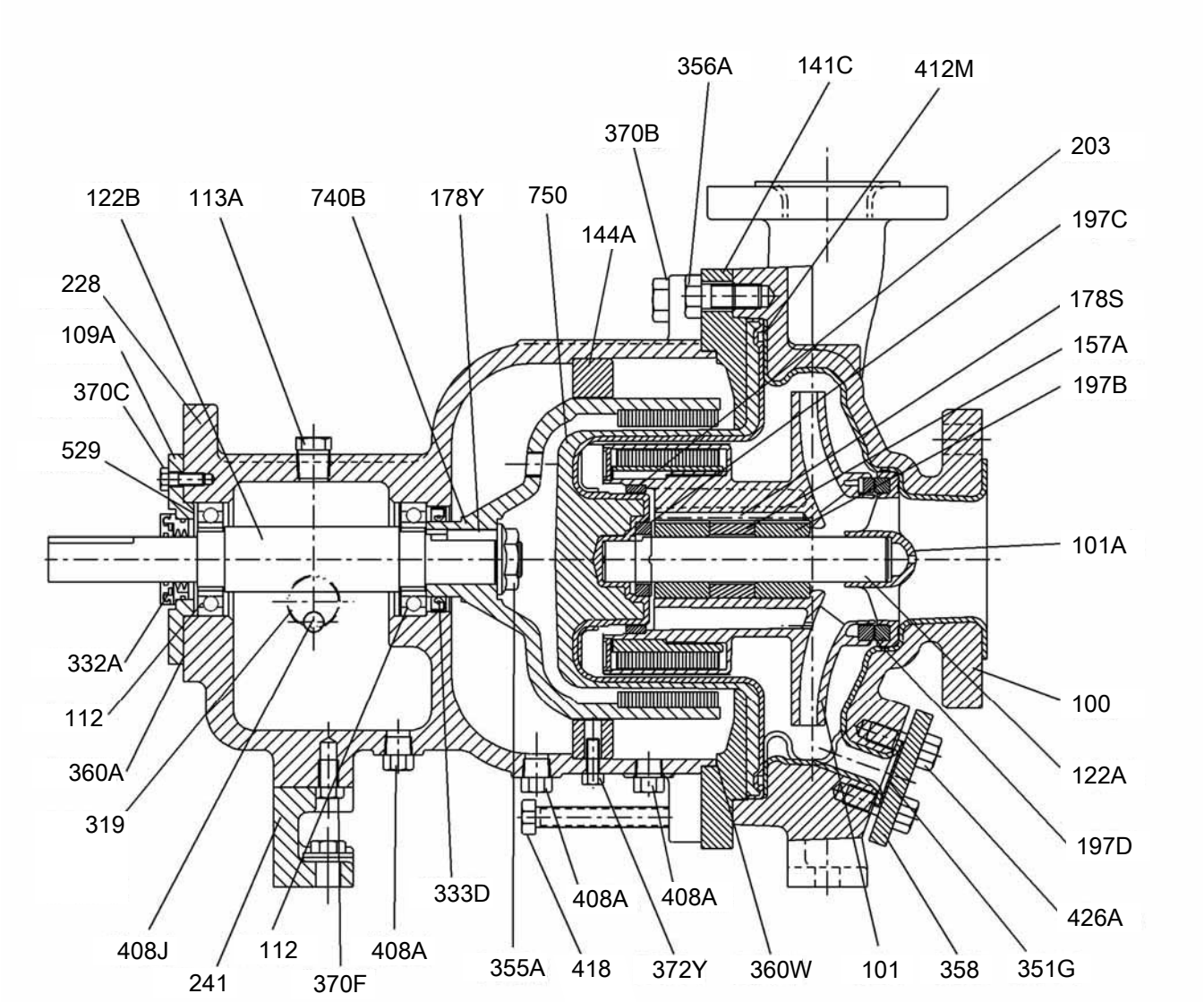
Item	Part name	Material
100	Casing	Ductile iron / Tefzel
101	Impeller assembly	Carbon-filled Tefzel
101A[1]	Bearing spider	Standard: carbon-filled Tefzel / silicon carbide Optional: carbon-filled Tefzel / Dry-guard silicon carbide
122A	Stationary shaft	Standard: silicon carbide Optional: Dry-guard silicon carbide
141C	Clamp ring	Ductile iron
157A	Bearing spacer – radial bearings	Teflon
178S[1]	Key – impeller to radial bearings	Teflon
178Y	Key – motor to carrier	Steel
197B[1]	Bearing – radial	Standard: carbon graphite Optional: silicon carbide Optional: Dry-guard silicon carbide
197C[1]	Bearing – reverse thrust	Carbon-filled Teflon
197D[1]	Bearing – impeller thrust	Standard: carbon-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
222L	Setscrew	Steel
228	Motor support – close coupled	Cast iron
351G[1]	Gasket – casing drain	Gylon
356A	Hex capscrew – clamp ring to casing	304 SS

Item	Part name	Material
358	Flange – casing drain	Steel
360W[1]	Gasket – motor support to clamp ring	Aramid fibers with EPDM
370B	Hex capscrew – motor support to clamp ring	304 SS
412M[1]	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon-encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
426A	Hex capscrew – casing drain	304 SS
492A	Access hole plug	Steel
740B	Drive magnet assembly	Cast iron / neodymium iron
750	Containment shell	Tefzel / fiber-reinforced vinylester
[1] Recommended spare parts		

Item	Part name	Material
228	Frame, close coupled (IEC)	Ductile iron
333L	Setscrew	304 SS
371	Hex capscrew – motor to frame	Carbon steel
388T	Hex capscrew – adapter to frame[1]	Carbon steel
408A	Plug – drain	Carbon steel
492A	Plug – access hole	Carbon steel
503	Ring – adapter[1]	Cast iron
742B	Ring – centering[2]	Carbon steel
[1]Used with motor frame 132 and 160 only. [2]Used with motor frames 80 and 90 only.		

3298 M group frame-mounted pump in sizes 3 x 4 - 7, 1-1/2 x 3 - 8, 2 x 3 - 8, 1 x 2 - 10

M group frame-mounted drawing



M group frame-mounted parts list

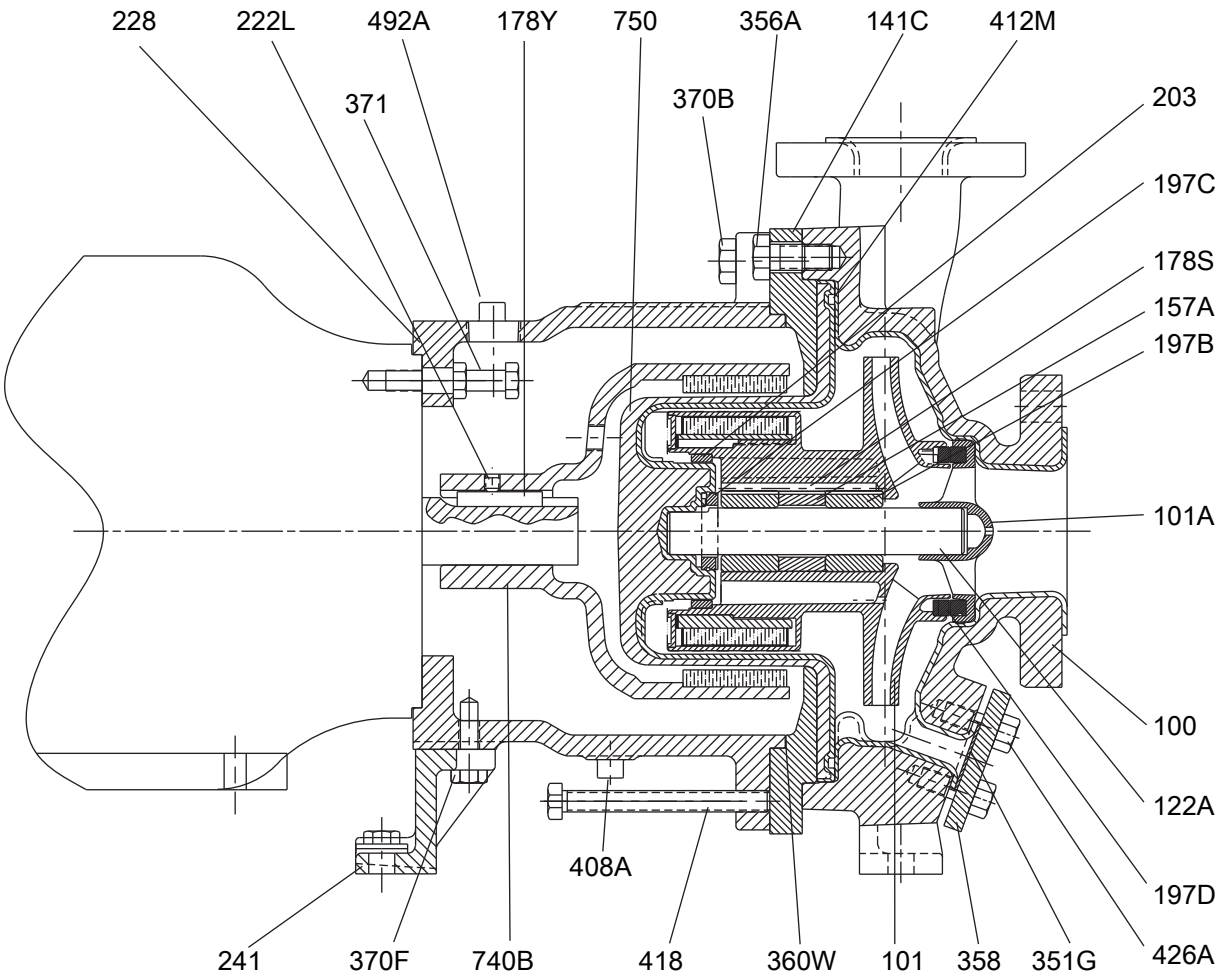
Item	Part name	Material
100	Casing	Ductile iron / Tefzel
101	Impeller assembly	Carbon-filled Tefzel
101A[1]	Bearing spider	Standard: carbon-filled Tefzel / silicon carbide Optional: carbon-filled Tefzel / Dry-guard silicon carbide
109A	End cover	Ductile iron

Item	Part name	Material
112[1]	Ball bearings	Steel
113A	Plug, oil fill	Steel
122A	Stationary shaft	Standard: silicon carbide Optional: Dry-guard silicon carbide
122B	Drive shaft	Steel
141C	Clamp ring	Ductile iron
144A	Rub ring	Cast iron
157A	Bearing spacer – radial	Teflon
178S[1]	Key – impeller to bearings	Teflon
178Y	Key – drive carrier	Steel
197B[1]	Bearing – radial	Standard: carbon graphite Optional: silicon carbide Optional: Dry-guard silicon carbide
197C[1]	Bearing – reverse thrust	Carbon-filled Teflon
197D[1]	Bearing – impeller thrust	Standard: carbon-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
203[1]	Wear ring – rear impeller	Carbon-filled Teflon
228	Frame – bearing	Cast iron
241	Frame foot	Cast iron
319	Sight window	Steel / glass
332A	Labyrinth seal	Carbon-filled Teflon
333D[1]	Lip seal	Buna rubber
351G[1]	Gasket – casing drain	Gylon
355A	Flanged hex nut	Steel
356A	Hex capscrew – clamp ring to casing	304 SS
358	Flange – casing drain	Steel
360A[1]	Gasket – end cover to frame	Varnished Kraft
360W[1]	Gasket – frame to clamp ring	Aramid fibers with EPDM
370B	Hex capscrew – frame to clamp ring	304 SS
370C	Hex capscrew – end cover to frame	304 SS
370F	Hex capscrew – frame foot	304 SS
372Y	Hex capscrew – frame to rub ring	304 SS
408A	Plug – drain	Steel
408J	Plug – oiler	Steel
412M[1]	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon Optional: Chemraz 505 Optional: Kalrez 4079
418	Hex tap bolt – jacking	304 SS
426A	Hex capscrew – casing drain	304 SS
529[1]	Washer – wave spring	Steel

Item	Part name	Material
740B	Drive carrier	Cast iron / neodymium iron
750	Containment shell	Tefzel / fiber-reinforced vinylester
[1] Recommended spare parts		

3298 M group close-coupled pump in sizes 3 x 4 - 7, 1-1/2 x 3 - 8, 2 x 3 - 8, 1 x 2 - 10

M group close-coupled drawing



M group close-coupled parts list

Item	Part name	Material
100	Casing	Ductile iron / Tefzel
101	Impeller assembly	Carbon-filled Tefzel
101A[1]	Bearing spider	Standard: carbon-filled Tefzel / silicon carbide Optional: carbon-filled Tefzel / Dry-guard silicon carbide
122A	Stationary shaft	Standard: silicon carbide Optional: Dry-guard silicon carbide
141C	Clamp ring	Ductile iron
157A	Bearing spacer – radial	Teflon

Item	Part name	Material
178S[1]	Key – impeller to bearings	Teflon
178Y	Key – motor to carrier	Steel
197B[1]	Bearing – radial	Standard: carbon graphite Optional: silicon carbide Optional: Dry-guard silicon carbide
197C[1]	Bearing – reverse thrust	Carbon-filled Teflon
197D[1]	Bearing – impeller thrust	Standard: carbon-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
203[1]	Wear ring – rear	Carbon-filled Teflon
222L	Setscrew	Steel
228	Frame – close coupled	Cast iron
351G[1]	Gasket – casing drain	Gylon
356A	Hex capscrew – clamp ring to casing	304 SS
358	Flange – casing drain	Steel
360W[1]	Gasket – frame support to clamp ring	Aramid fibers with EPDM
370B	Hex capscrew – frame to clamp ring	304 SS
370F	Hex capscrew – frame foot	304 SS
371	Hex capscrew – frame to motor	304 SS
408A	Plug – drain	Steel
412M[1]	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon- encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
418	Hex tap bolt – jacking	304 SS
426A	Hex capscrew – casing drain	304 SS
492A	Plug – access hole	Steel
740B	Drive carrier	Cast iron / neodymium iron
750	Containment shell	Tefzel / fiber-reinforced vinylester
[1] Recommended spare parts		

3298 L group frame-mounted pump in sizes 1-1/2 x 3 - 10, 2 x 3 - 10, 3 x 4 - 10G, 3 x 4 - 10H, and 4 x 6 - 10

L group frame-mounted drawing

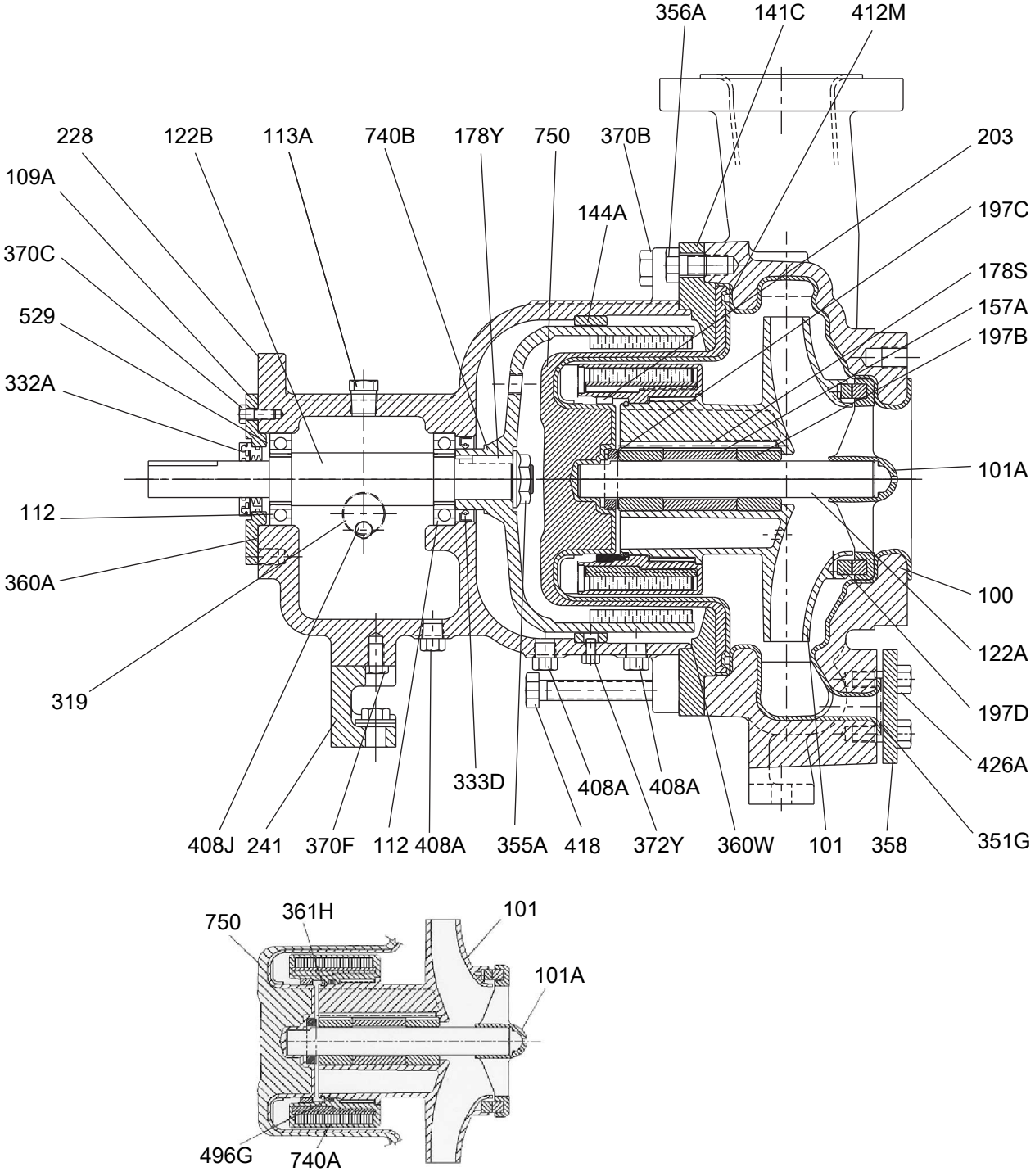


Figure 78: Two-piece impeller

L group frame-mounted parts list

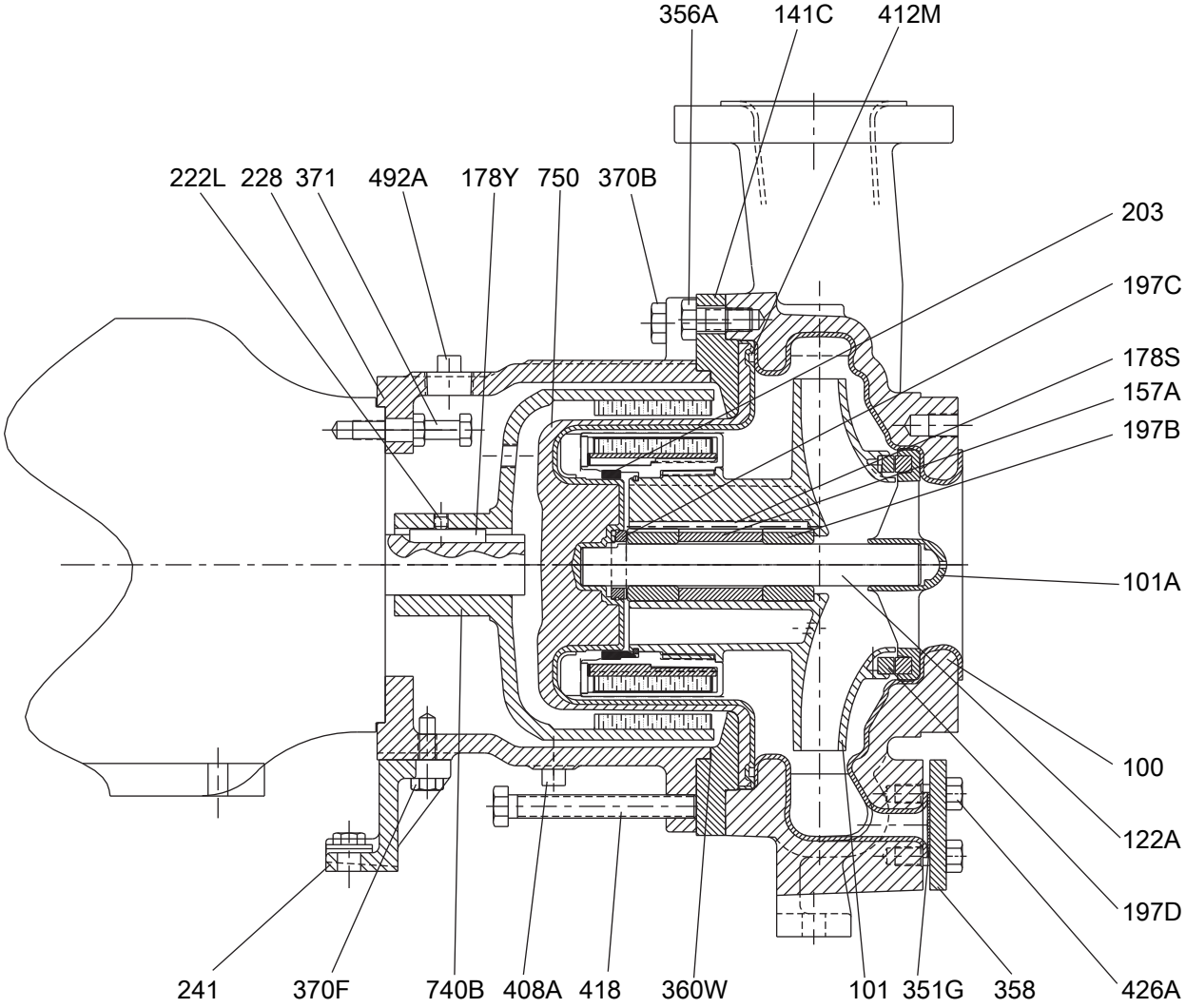
Item	Part name	Material
100	Casing	Ductile iron / Tefzel

Item	Part name	Material
101	Impeller assembly	Carbon-fiber-reinforced Tefzel
101A[1]	Bearing spider	Standard: carbon-filled Tefzel / silicon carbide Optional: carbon-filled Tefzel / Dry-guard silicon carbide
109A	End cover	Ductile iron
112[1]	Ball bearings	Steel
113A	Plug – oil fill	Steel
122A	Stationary shaft	Standard: silicon carbide Optional: Dry-guard silicon carbide
122B	Drive shaft	Steel
141C	Clamp ring	Ductile iron
144A	Rub ring	Cast iron
157A	Bearing spacer – radial	Teflon
178S[1]	Key – impeller to bearings	Teflon
178Y	Key – drive carrier	Steel
197B[1]	Bearing – radial	Standard: carbon graphite Optional: silicon carbide Optional: Dry-guard silicon carbide
197C[1]	Bearing, reverse thrust	Carbon-filled Teflon
197D[1]	Bearing – impeller thrust	Standard: carbon-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
203[1]	Wear ring – rear impeller	Carbon-filled Teflon
228	Frame – bearing	Cast iron
241	Frame foot	Cast iron
319	Sight window	Steel / glass
332A	Labyrinth seal	Carbon-filled Teflon
333D[1]	Lip seal	Buna rubber
351G[1]	Gasket – casing drain	Gylon
355A	Flanged hex nut	Steel
356A	Hex capscrew – clamp ring to casing	304 SS
358	Flange – casing drain	Steel
360A[1]	Gasket – end cover to frame	Varnished Kraft
360W[1]	Gasket – frame to clamp ring	Aramid fibers with EPDM
361H	Retaining ring	Teflon-encapsulated silicone
370B	Hex capscrew – frame to clamp ring	304 SS
370C	Hex capscrew – end cover to frame	304 SS
370F	Hex capscrew – frame foot	304 SS
372Y	Hex capscrew – frame to rub ring	304 SS
408A	Plug – drain	Steel
408J	Plug – oiler	Steel

Item	Part name	Material
412M[1]	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon Optional: Chemraz 505 Optional: Kalrez 4079
418	Hex tap bolt – jacking	304 SS
426A	Hex capscrew – casing drain	304 SS
496G[1]	O-ring – drive magnet assembly	Standard: Viton Optional: EPDM Optional: Teflon Optional: Chemraz 505 Optional: Kalrez 4079
529[1]	Washer – wave spring	Steel
740A	Drive magnet assembly	Tefzel / neodymium iron
740B	Drive carrier	Cast iron / neodymium iron
750	Containment shell	Carbon-filled Tefzel / fiber-reinforced vinylester
[1] Recommended spare parts		

3298 L group close-coupled pump in sizes 1-1/2 x 3 - 10, 2 x 3 - 10, 3 x 4 - 10G, 3 x 4 - 10H, and 4 x 6 - 10

L group close-coupled drawing



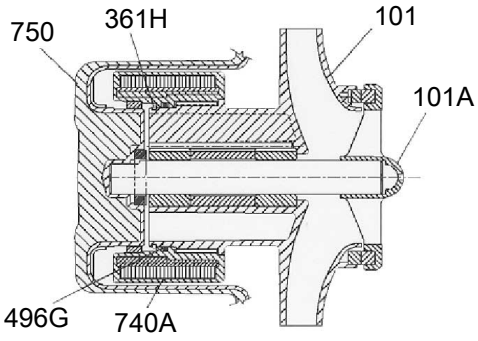


Figure 79: Two-piece impeller

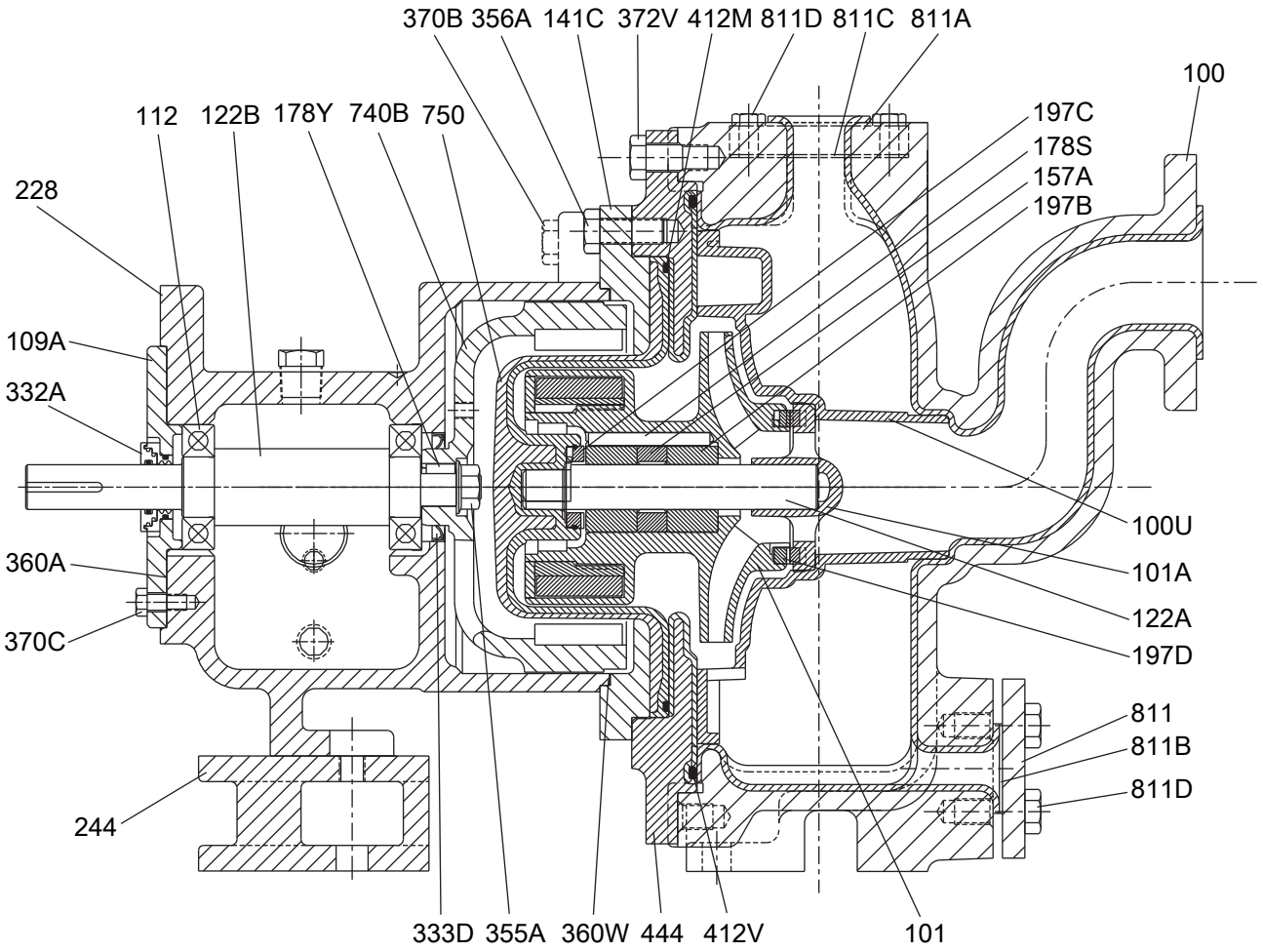
L group close-coupled parts list

Item	Part name	Material
100	Casing	Ductile iron / Tefzel
101	Impeller assembly	Carbon-filled Tefzel
101A[1]	Bearing spider	Standard: carbon-filled Tefzel / silicon carbide Optional: carbon-filled Tefzel / Dry-guard silicon carbide
122A	Stationary shaft	Standard: silicon carbide Optional: Dry-guard silicon carbide
141C	Clamp ring	Ductile iron
157A	Bearing spacer – radial	Teflon
178S[1]	Key – impeller to bearings	Teflon
178Y	Key – motor to carrier	Steel
197B[1]	Bearing – radial	Standard: carbon graphite Optional: silicon carbide Optional: Dry-guard silicon carbide
197C[1]	Bearing – reverse thrust	Carbon-filled Teflon
197D[1]	Bearing – impeller thrust	Standard: carbon-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
203[1]	Wear ring – rear	Carbon-filled Teflon
222L	Setscrew	Steel
228	Frame – close coupled	Cast iron
241	Frame foot	Cast iron
351G[1]	Gasket – casing drain	Gylon
356A	Hex capscrew – clamp ring to casing	304 SS
358	Flange – casing drain	Steel
360W[1]	Gasket – frame support to clamp ring	Aramid fibers with EPDM
361H	Retaining ring	Teflon-encapsulated silicone
370B	Hex capscrew – frame to clamp ring	304 SS
370F	Hex capscrew – frame foot	304 SS
371	Hex capscrew – frame to motor	304 SS
408A	Plug – drain	Steel
412M[1]	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon-encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
418	Hex tap bolt – jacking	304 SS
426A	Hex capscrew – casing drain	304 SS
492A	Plug – access hole	Steel

Item	Part name	Material
496G	O-ring – drive magnet assembly	Standard: Viton Optional: EPDM Optional: Teflon-encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
740A	Drive magnet assembly	Tefzel / neodymium iron
740B	Drive carrier	Cast iron / neodymium iron
750	Containment shell	Tefzel / fiber-reinforced vinylester
[1] Recommended spare parts		

SP3298 S group frame-mounted pump in sizes 1 x 1-1/2 - 6 and 2 x 3 - 6

SP3298 S group frame-mounted drawing



SP3298 S group frame-mounted parts list

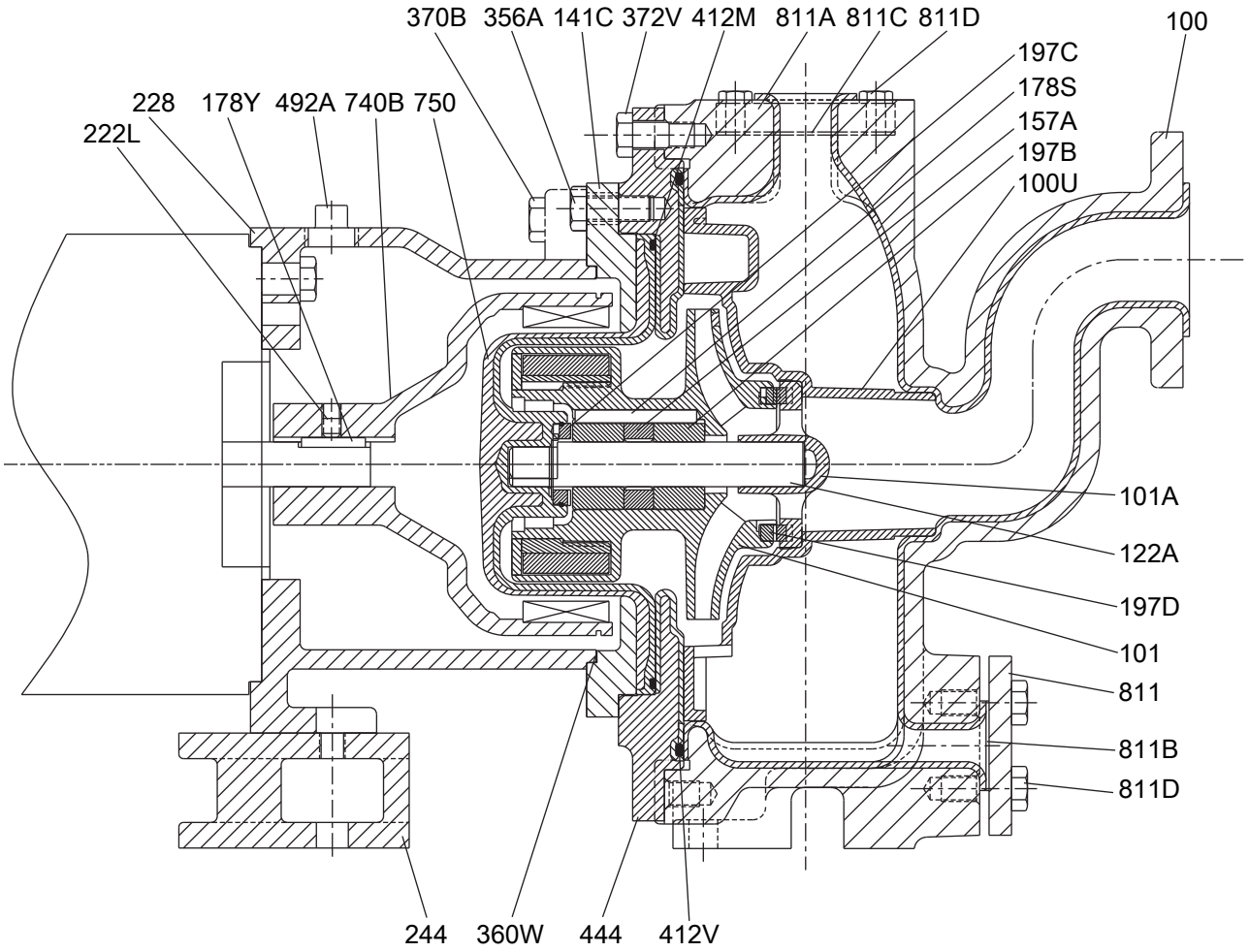
Item	Part name	Material
100	Casing	Ductile iron / Tefzel
100U	Volute insert	Carbon-filled Tefzel
101	Impeller assembly	Tefzel

Item	Part name	Material
101A[1]	Bearing spider	Tefzel / silicon carbide
109A	End cover	Ductile iron
112[1]	Ball bearings	Steel
113A	Plug – oil fill	Steel
122A	Stationary shaft	Silicon carbide
122B	Drive shaft	Steel
141C	Clamp ring	Ductile iron
157A	Bearing spacer – radial	Teflon
178S[1]	Key – impeller to radial bearings	Tefzel
178Y	Key – drive carrier	Steel
197B[1]	Bearing – radial	Standard: carbon Optional: silicon carbide Optional: Dry-guard silicon carbide
197C[1]	Bearing – reverse thrust	Carbon-filled Teflon
197D[1]	Bearing – impeller thrust	Standard: carbon-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
203	Wear ring – rear	Carbon-filled Teflon
228	Frame – bearing	Cast iron
319	Sight window	steel / glass
332A[1]	Labyrinth seal	Carbon-filled Teflon
333D[1]	Lip seal	Buna rubber
355A[1]	Flanged hex nut	Steel
356A	Hex capscrew – clamp ring to backplate	304 SS
360A[1]	Gasket – end cover to frame	Varnished Kraft
360W	Gasket – frame to clamp ring	Aramid fibers with EPDM
370B	Hex capscrew – frame to clamp ring	304 SS
370C	Hex capscrew – end cover to frame	304 SS
372V	Hex capscrew – backplate to casing	304 SS
408A	Plug – drain	Steel
408J	Plug – oiler	Steel
412M[1]	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon-encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
412V	O-ring – backplate	Standard: Viton Optional: EPDM Optional: Teflon-encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
444	Backplate	Ductile iron / Tefzel
740B	Drive magnet assembly	Cast iron / neodymium iron
750	Containment shell	Tefzel / fiber-reinforced vinylester

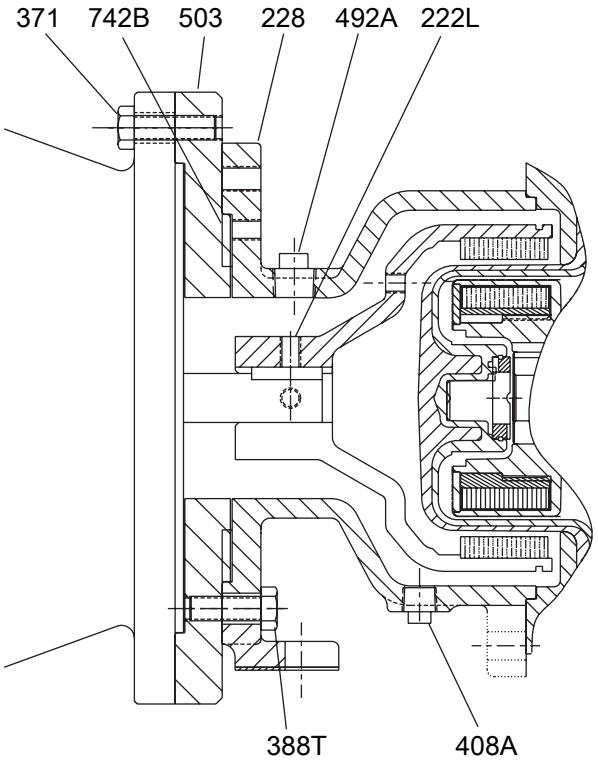
Item	Part name	Material
811	Cover – casing drain	Carbon steel
811A	Cover – casing fill	Carbon steel
811B	Gasket – casing drain	Non-asbestos packing
811C	Gasket – casing fill	Non-asbestos packing
811D	Hex capscrew – drain cover	304 SS
[1] Recommended spare parts		

SP3298 S group close-coupled pump in sizes 1 x 1-1/2 - 6 and 2 x 3 - 6

SP3298 S group close-coupled drawing, with NEMA motor



SP3298 S group close-coupled drawing, with IEC motor



SP3298 S group close-coupled drawing

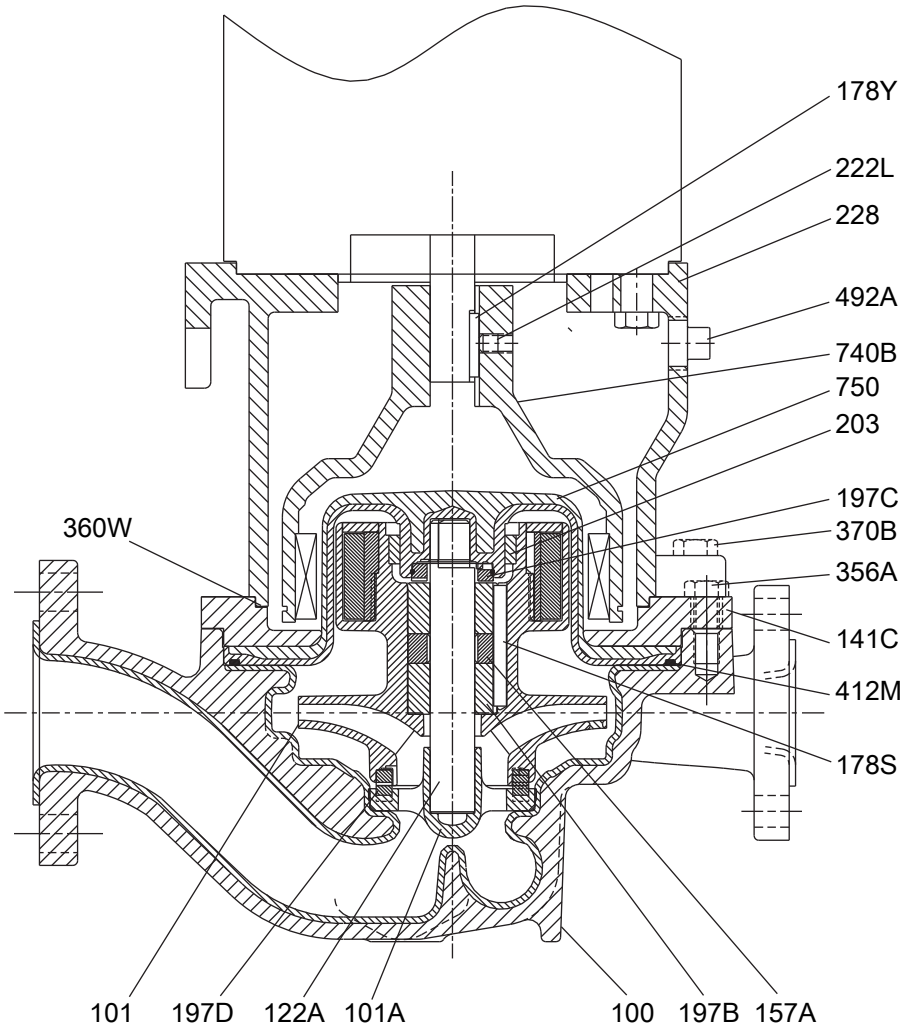
Item	Part name	Material
100	Casing	Ductile iron / Tefzel
100U	Volute insert	Carbon-filled Tefzel
101	Impeller assembly	Tefzel
101A[1]	Bearing spider	Tefzel / silicon carbide
122A	Stationary shaft	Silicon carbide
141C	Clamp ring	Ductile iron
157A	Bearing spacer – radial	Teflon
178S[1]	Key – impeller to radial bearings	Tefzel
178Y	Key – motor to drive carrier	Steel
197B[1]	Bearing – radial	Standard: carbon Optional: silicon carbide Optional: Dry-guard silicon carbide
197C[1]	Bearing – reverse thrust	Carbon-filled Teflon
197D[1]	Bearing – impeller thrust	Standard: carbon-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
222L	Setscrew	303 SS
228	Frame – close coupled (NEMA)	Cast iron
356A	Hex capscrew – clamp ring to backplate	304 SS
360W[1]	Gasket – support to clamp ring	Aramid fibers with EPDM
370B	Hex capscrew – frame to clamp ring	304 SS
372V	Hex capscrew – backplate to casing	304 SS

Item	Part name	Material
412M[1]	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon-encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
412V[1]	O-ring – backplate	Standard: Viton Optional: EPDM Optional: Teflon-encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
444	Backplate	Ductile iron / Tefzel
492A	Plug – access hole	Steel
740B	Drive magnet assembly	Cast iron / neodymium iron
750	Containment shell	Tefzel / fiber-reinforced vinylester
811	Cover – casing drain	Carbon steel
811A	Cover – casing fill	Carbon steel
811B	Gasket – casing drain	Non-asbestos packing
811C	Gasket – casing fill	Non-asbestos packing
811D	Hex capscrew – drain cover	304 SS
[1] Recommended spare parts		

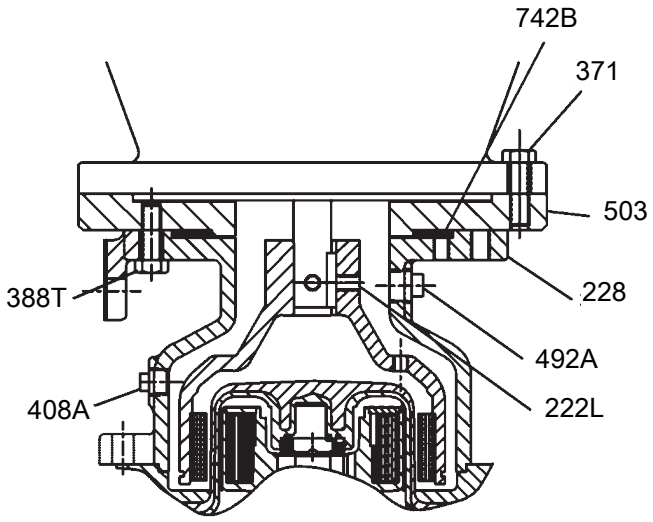
Item	Part name	Material
228	Frame – close coupled (IEC)	Ductile iron
222L	Setscrew	304 SS
371	Hex capscrew – motor to frame	Carbon steel
388T	Hex capscrew – adapter to frame[1]	Carbon steel
408A	Plug – drain	Carbon steel
492A	Plug – access hole	Carbon steel
503	Ring – adapter[1]	Cast iron
742B	Ring – centering[2]	Carbon steel
[1]Used with motor frame 132 and 160 only. [2]Used with motor frames 80 and 90 only.		

V3298 close-coupled S group pump in sizes 1-1/2 x 2 - 6, 2 x 3 - 6, 1-1/2 x 2 - 8 and M group size 1-1/2 x 2 - 10

V3298 S and M group drawing, with NEMA motor



V3298 S and M group drawing, with IEC motor



V3298 close-coupled S and M group parts list

Item	Part name	Material
100	Casing	Ductile iron / Tefzel
101	Impeller assembly	Tefzel
101A	Bearing spider	Tefzel / silicon carbide
122A	Stationary shaft	Silicon carbide
141C	Clamp ring	Ductile iron
157A	Bearing spacer – radial	Teflon
178S	Key – impeller to radial bearings	Tefzel
178Y	Key – motor to magnet assembly	Steel
197B	Bearing – radial	Standard: carbon Optional: silicon carbide Optional: Dry-guard silicon carbide
197C	Bearing – reverse thrust	Carbon-filled Teflon
197D	Bearing – impeller thrust	Standard: carbon-filled Teflon Optional: silicon carbide Optional: Dry-guard silicon carbide
203	Wear ring – rear	Carbon-filled Teflon
222L	Setscrew	303 SS
228	Frame – close coupled (NEMA)	Cast iron
351G	Gasket – casing drain	Non-asbestos packing
356A	Hex capscrew – clamp ring to casing	304 SS
358	Cover – drain	Steel
360W	Gasket – support to clamp ring	Aramid fibers with EPDM
370B	Hex capscrew – backplate to clamp ring	304 SS

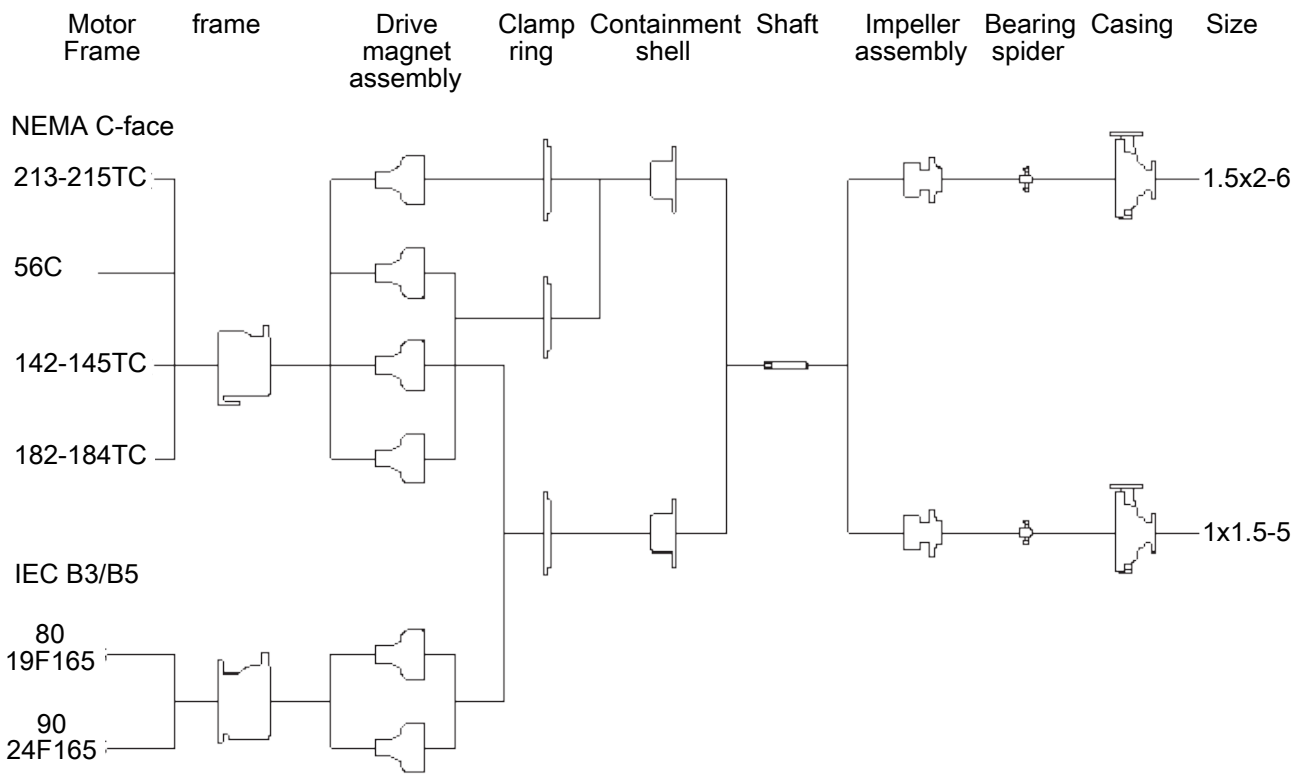
Item	Part name	Material
412M	O-ring – containment shell	Standard: Viton Optional: EPDM Optional: Teflon-encapsulated Viton Optional: Chemraz 505 Optional: Kalrez 4079
426A	Hex capscrew – drain cover	304 SS
492A	Plug – access hole	Steel
740B	Drive magnet assembly	Cast iron / neodymium iron
750	Containment shell	Tefzel / fiber-reinforced vinylester

Item	Part name	Material
228	Frame – close coupled (IEC)	Ductile iron
222L	Setscrew	304 SS
371	Hex capscrew – motor to frame	Carbon steel
388T	Hex capscrew – adapter to frame[1]	Carbon steel
408A	Plug – drain	Carbon steel
492A	Plug – access hole	Carbon steel
503	Ring ,– adapter[1]	Cast iron
742B	Ring – centering[2]	Carbon steel

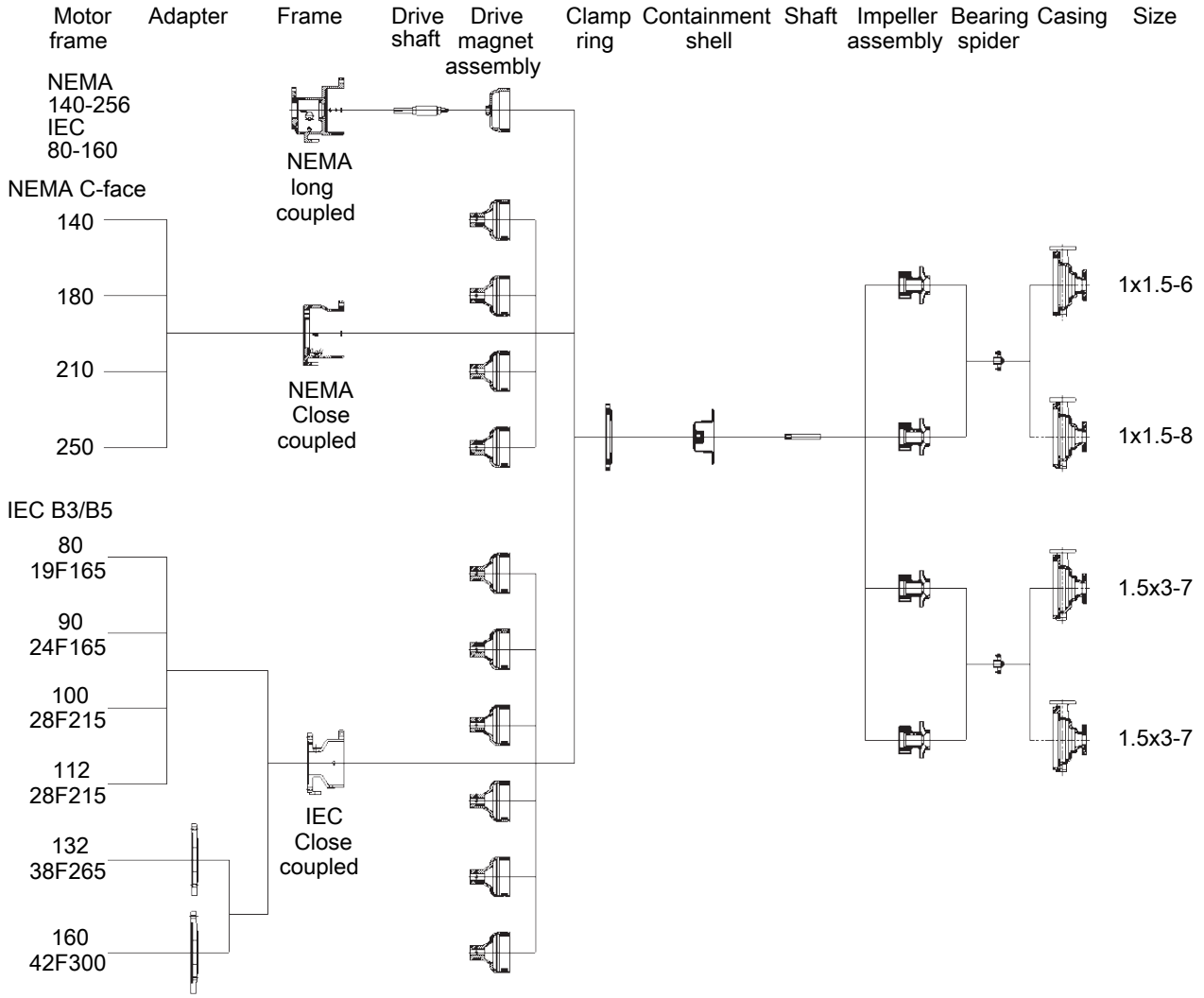
[1]Used with motor frame 132 and 160 only.
[2]Used with motor frames 80 and 90 only.

Interchangeability drawings

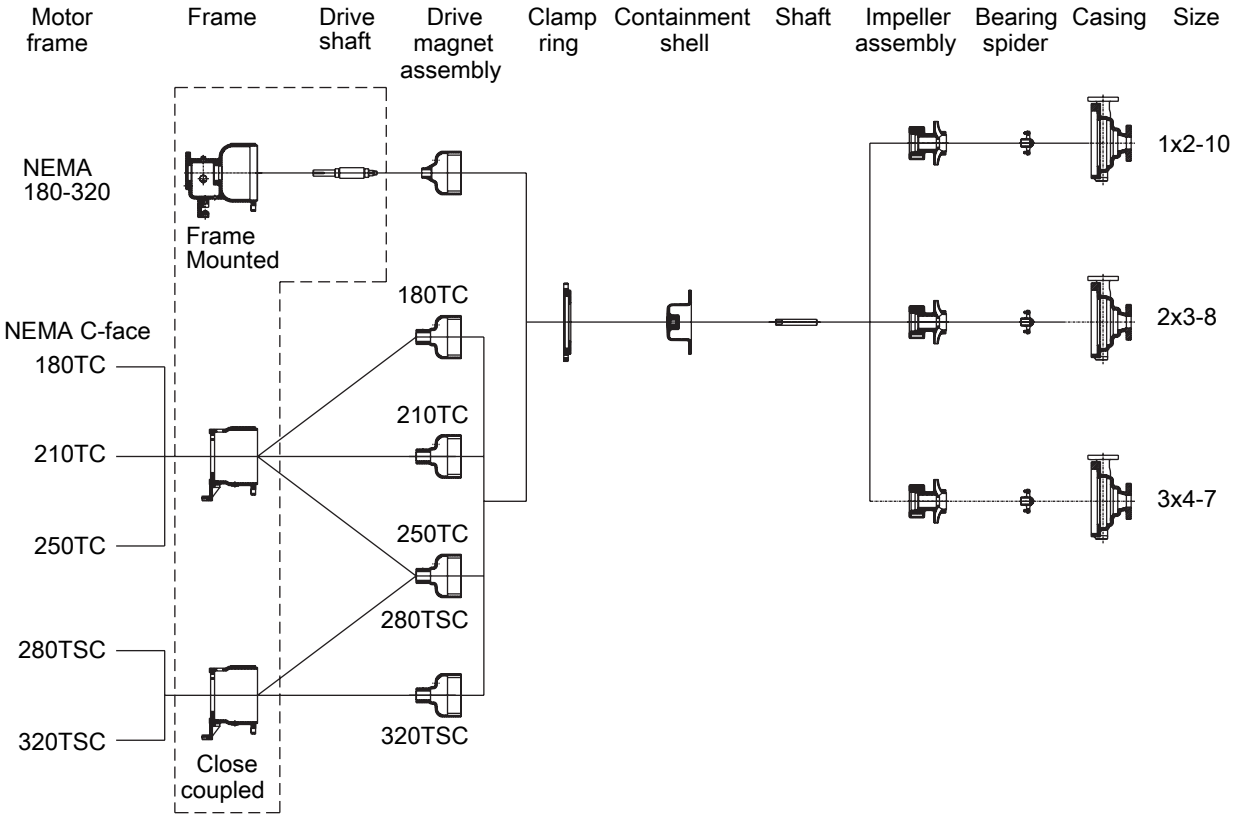
3298 XS group interchangeability



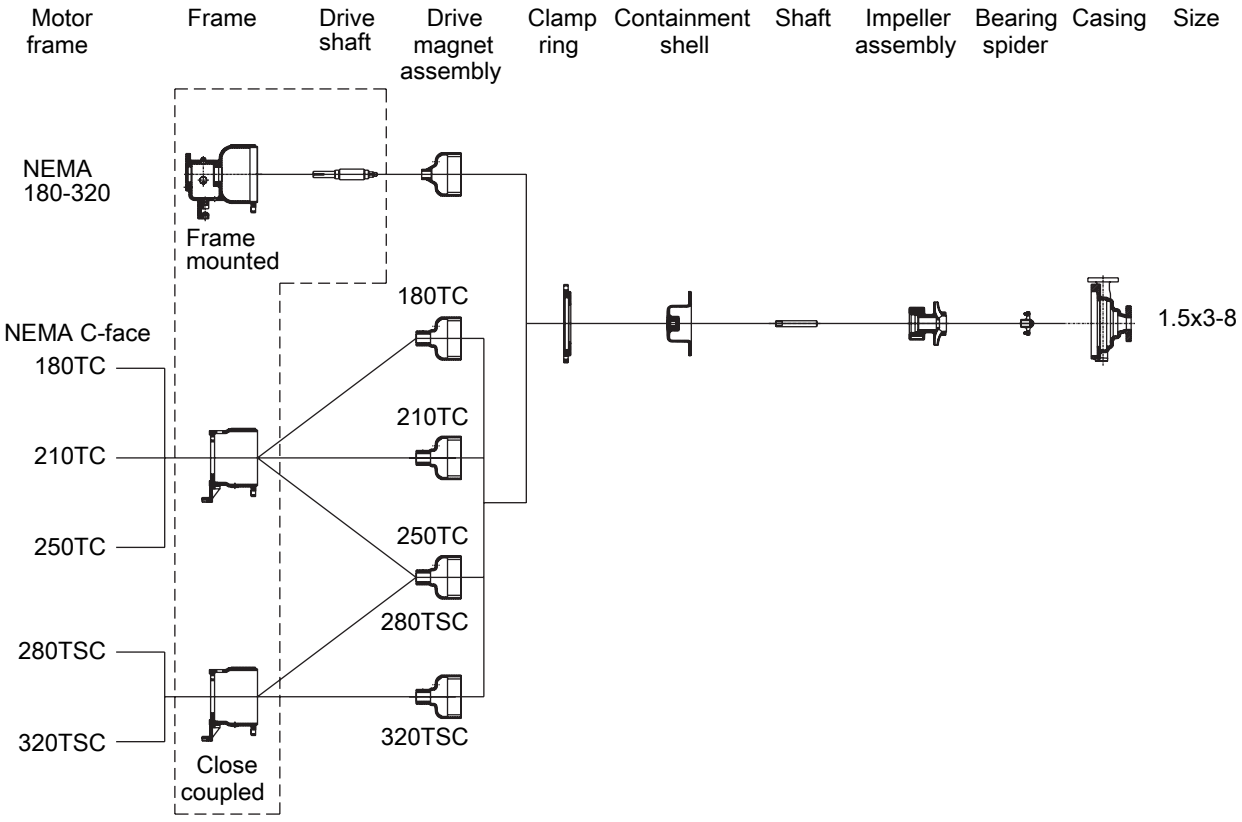
3298 S group interchangeability



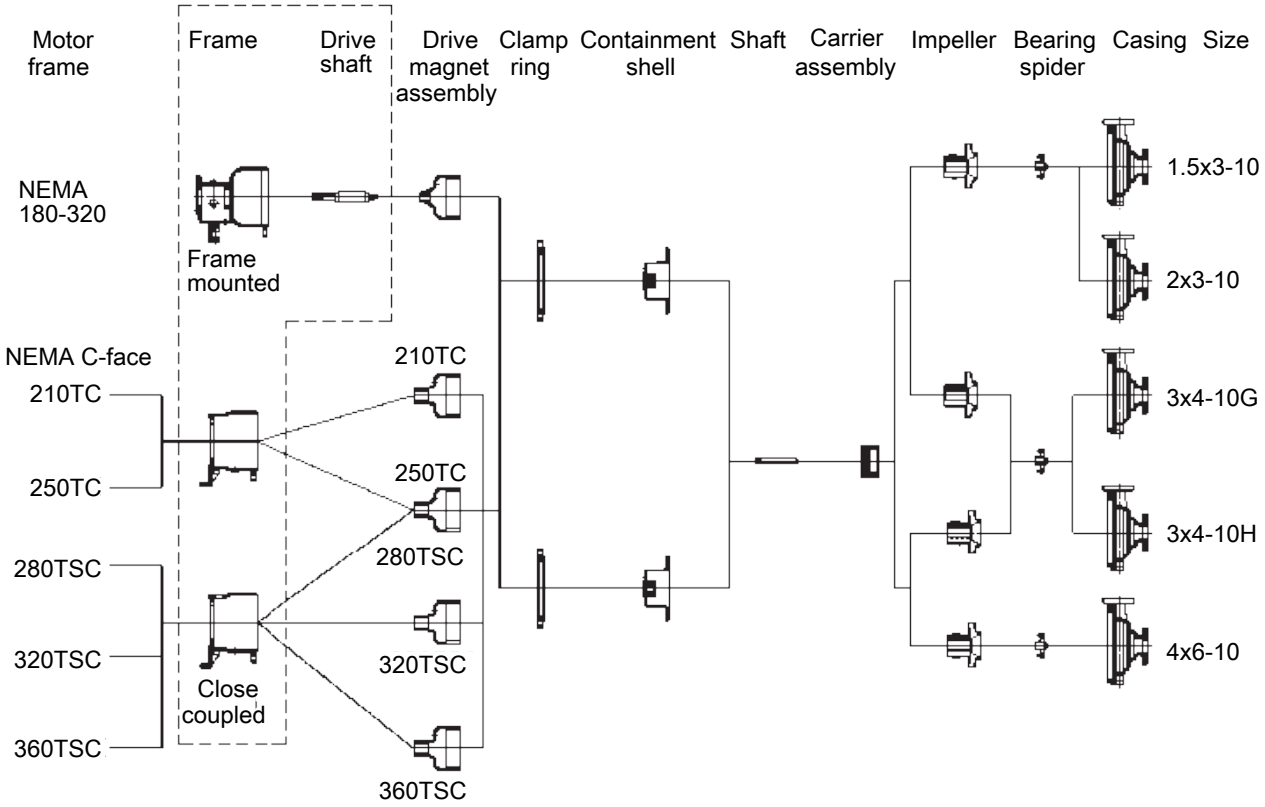
3298 M group interchangeability



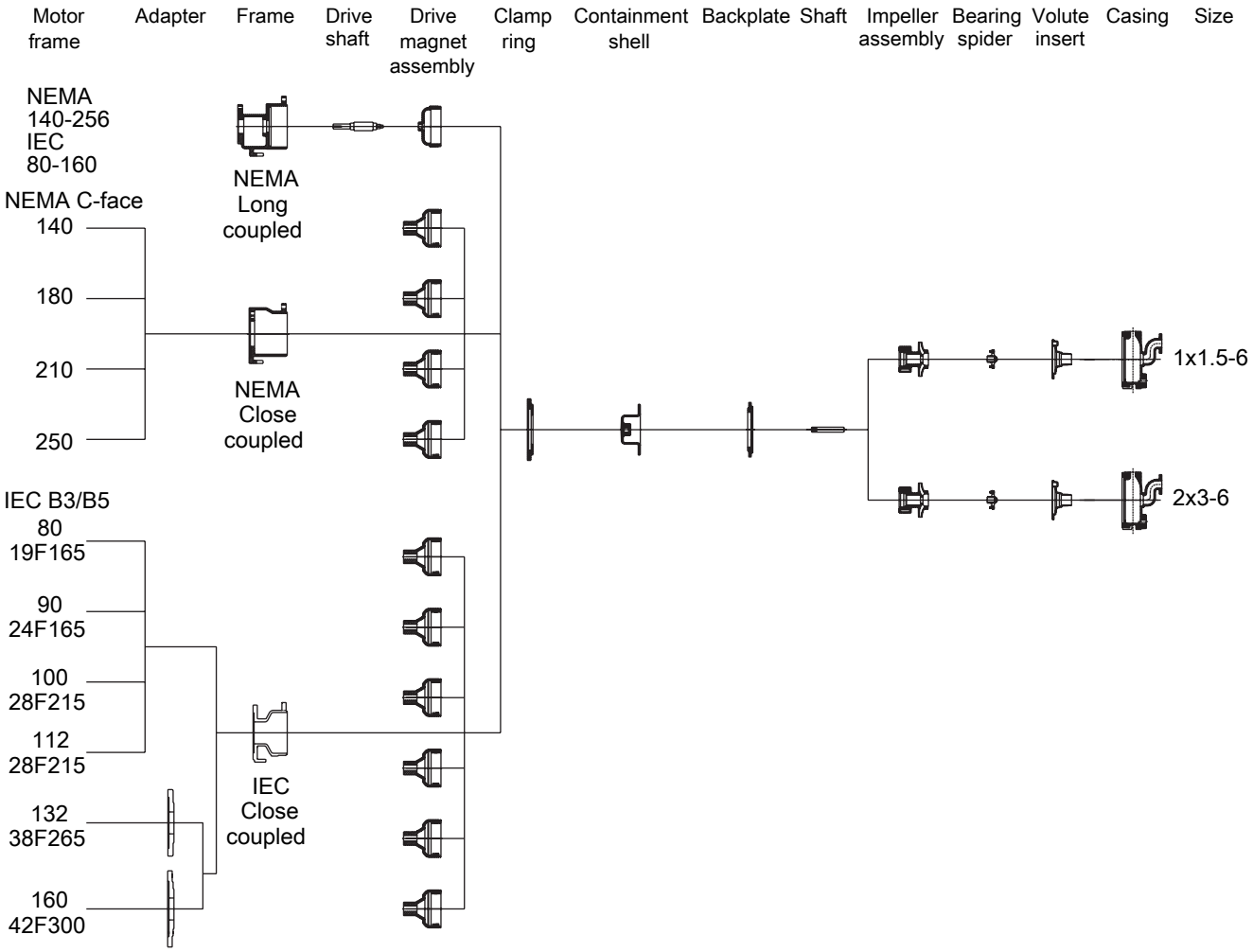
3298 M group interchangeability – size 1½ x 3-8 only



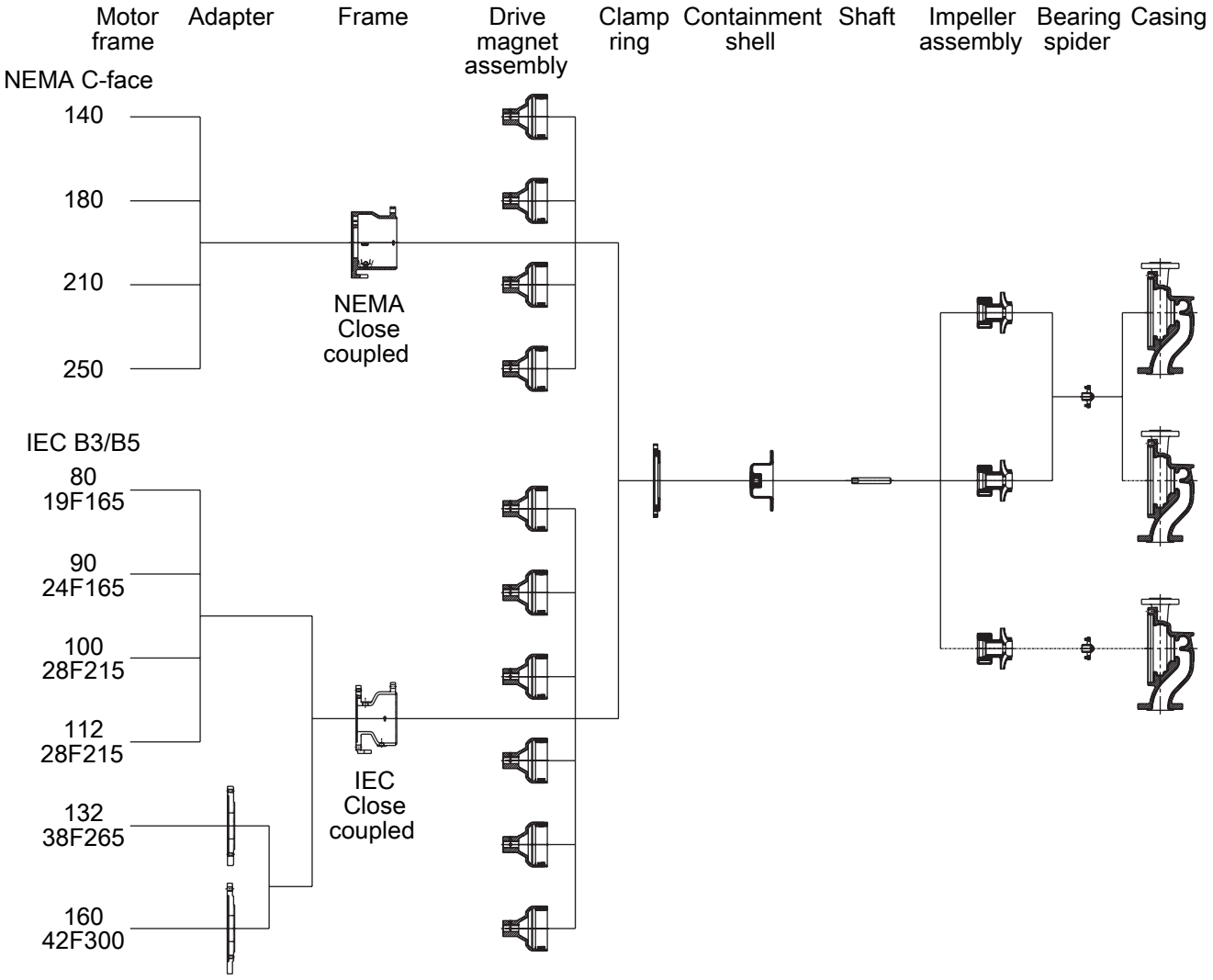
3298 L group interchangeability



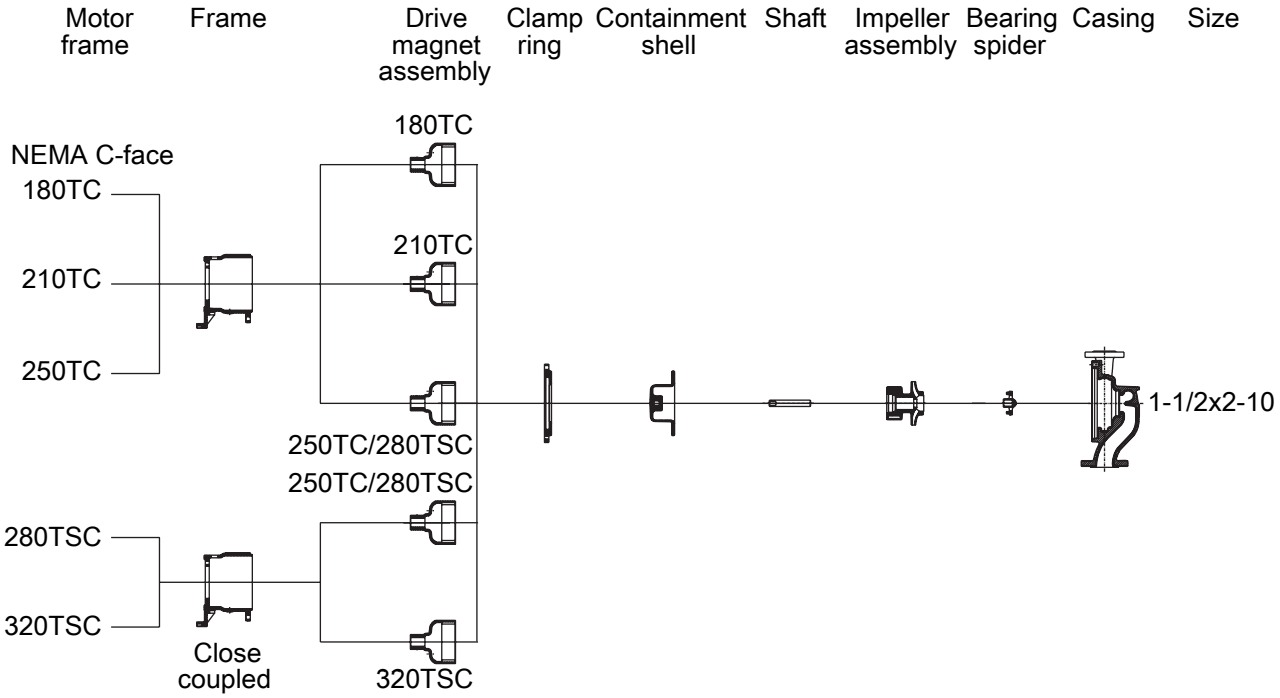
SP3298 S group interchangeability



V3298 S group interchangeability

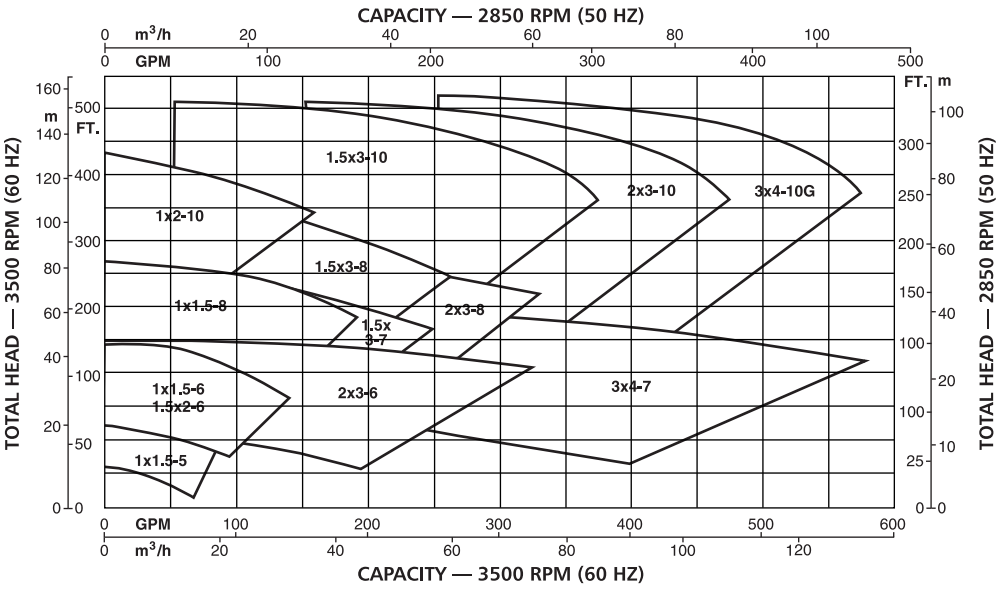


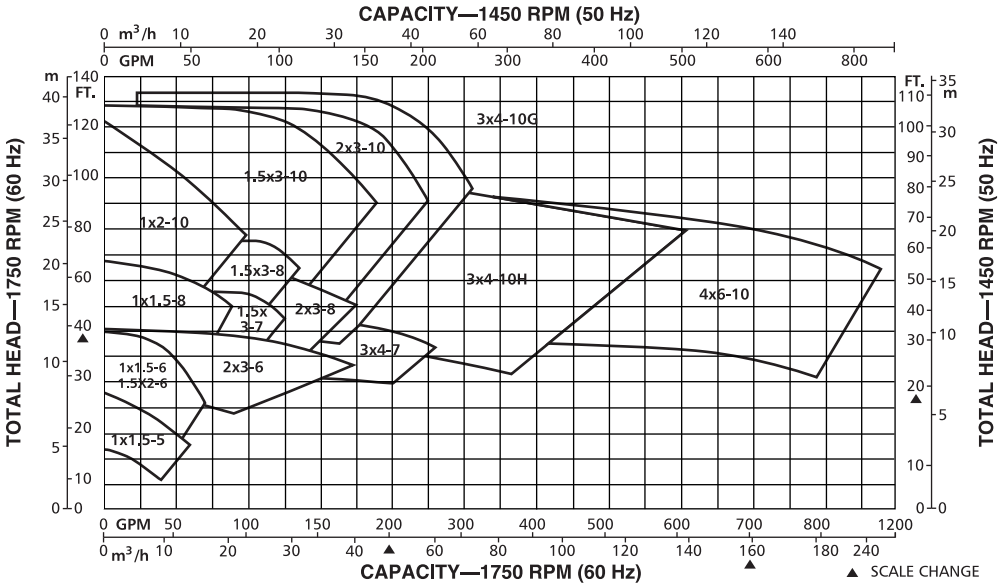
V3298 M group interchangeability



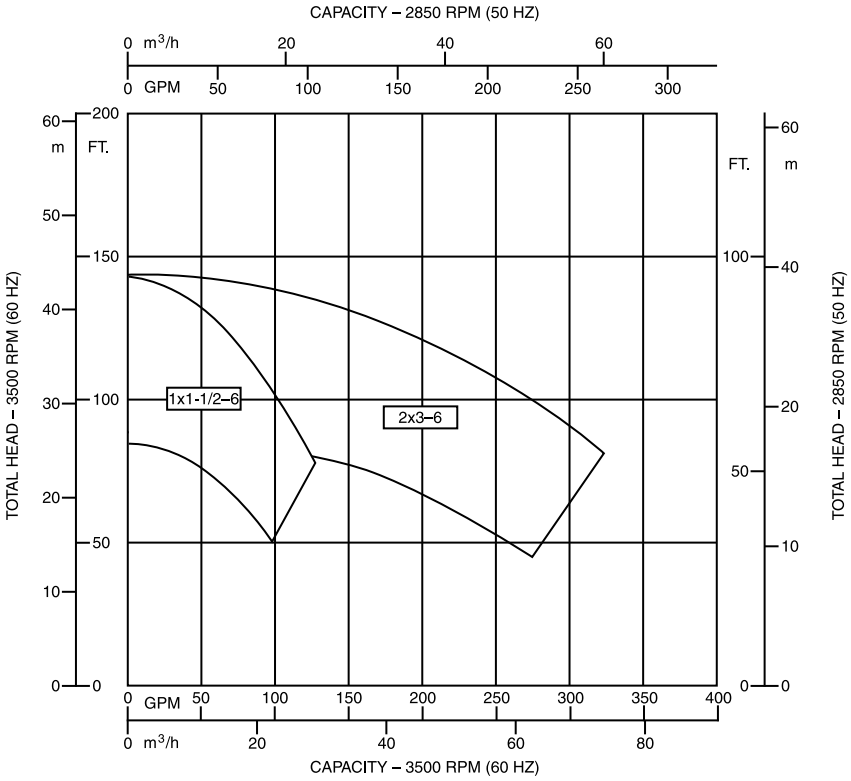
Hydraulic coverage charts

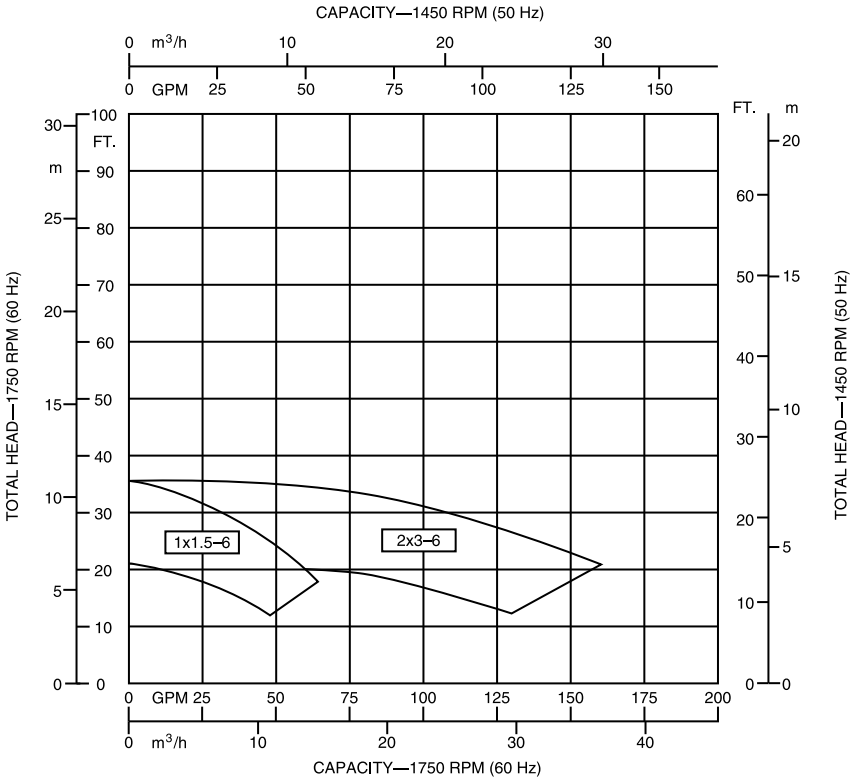
3298 charts



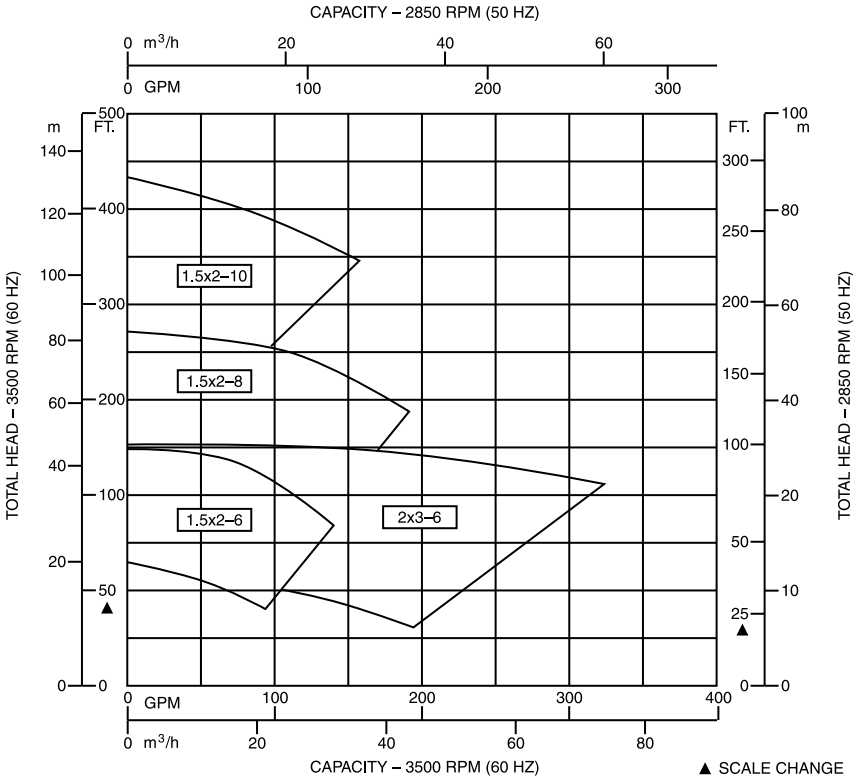


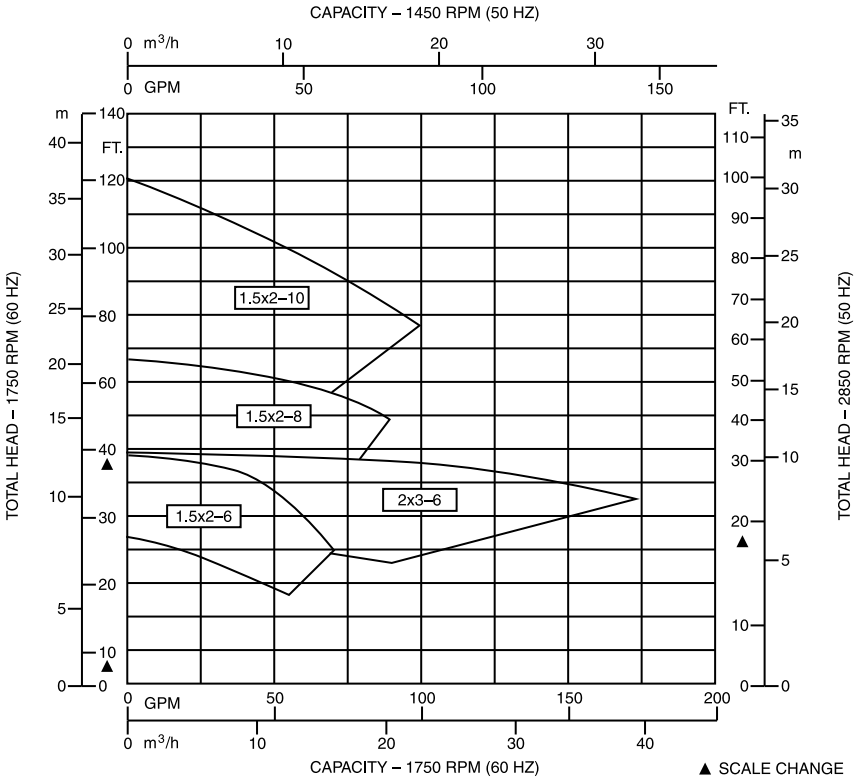
SP3298 charts





V3298 charts




CAPACITY – 1450 RPM (50 HZ)
0 m3/h 10 20 30
0 GPM 50 100 150
m
FT.
TOTAL HEAD – 1750 RPM (60 HZ)
1.5x2–10
1.5x2–8
1.5x2–6
2x3–6
TOTAL HEAD – 2850 RPM (50 HZ)
0 GPM 50 100 150 200
0 m3/h 10 20 30 40
CAPACITY – 1750 RPM (60 HZ)
▲ SCALE CHANGE

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